Feb. 19, 1963 L. E. MUELLER 3,077,674

MAT DRYING APPARATUS

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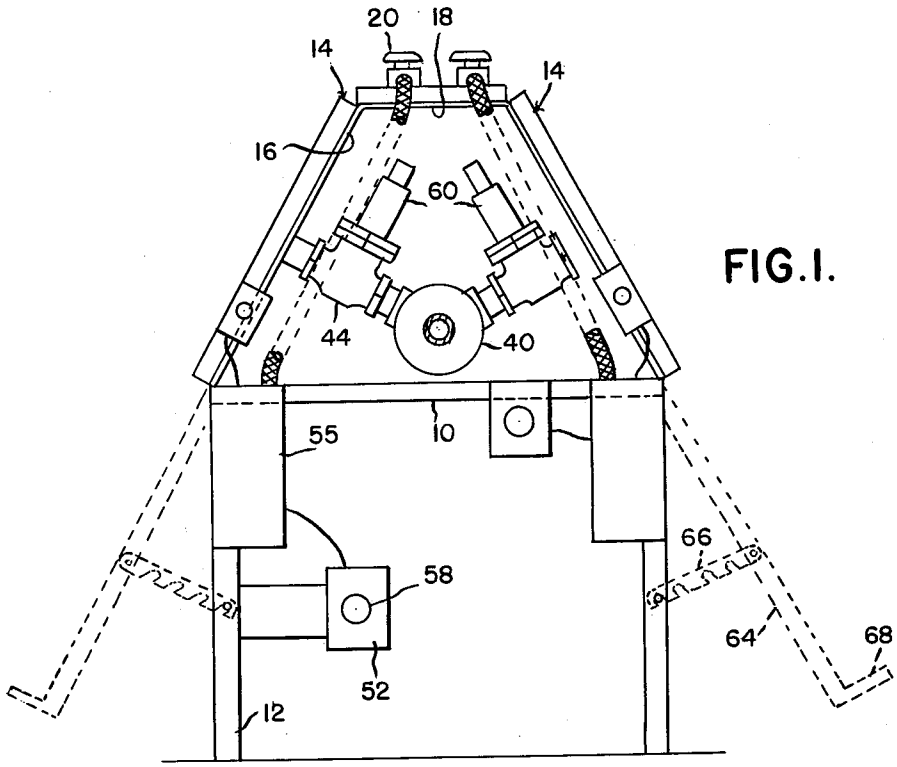
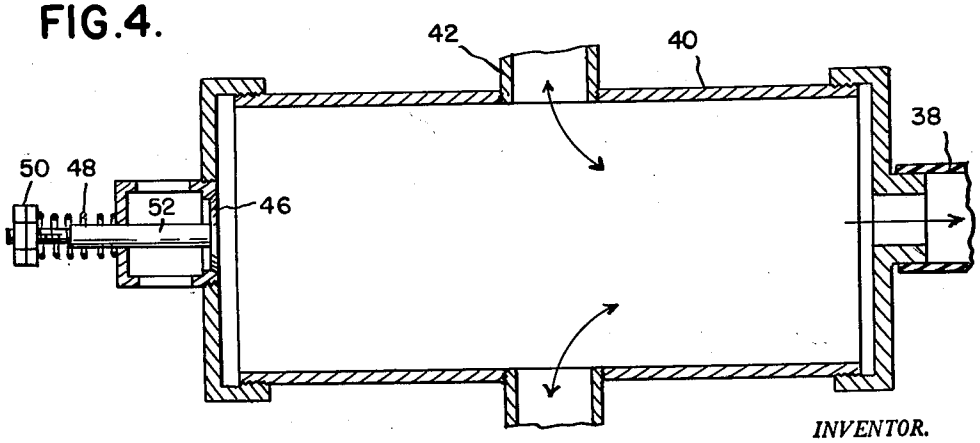


FIG.1.

FIG.4.



INVENTOR.
LOUIS E. MUELLER
BY Hulbert & Belknap
ATTORNEYS

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MAT DRYING APPARATUS

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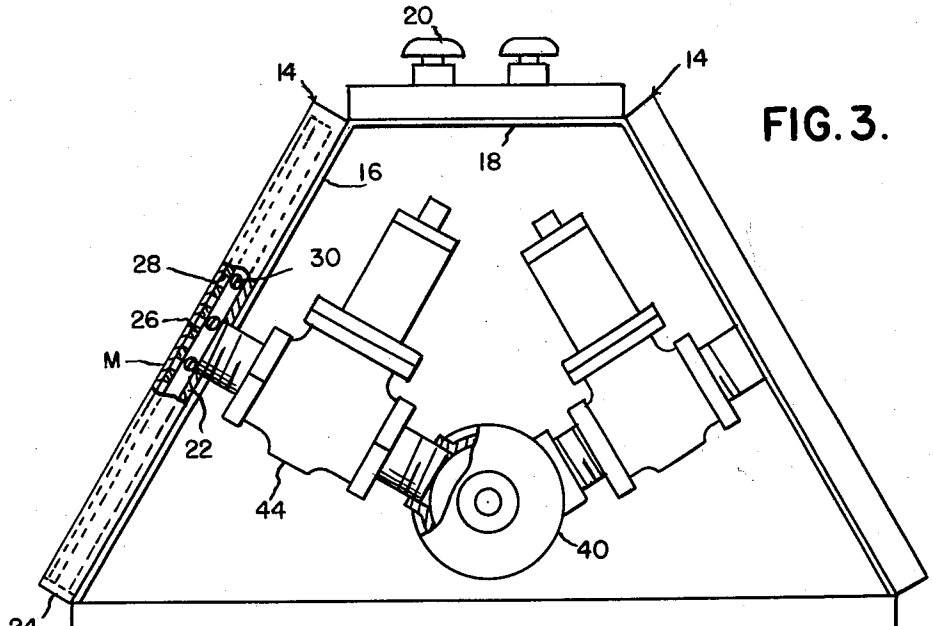


FIG. 3.

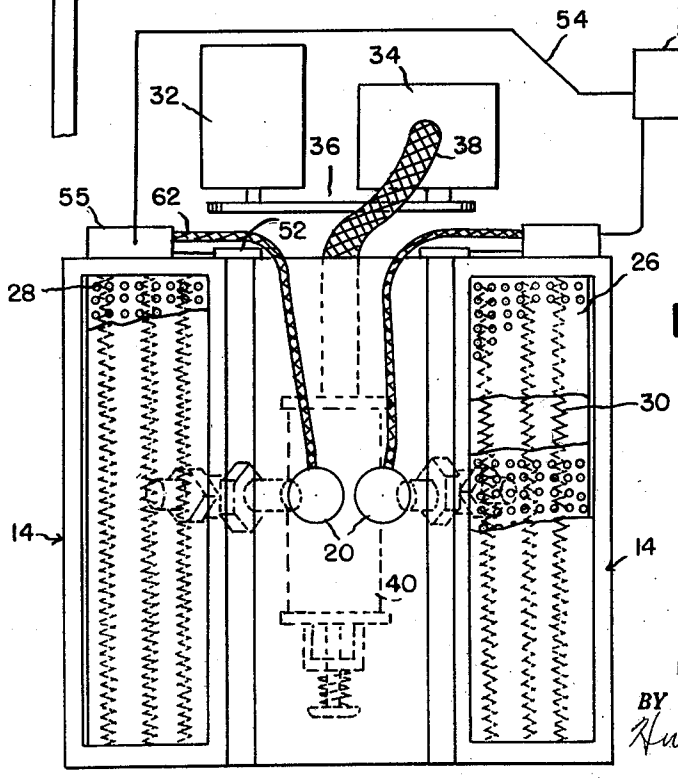


FIG. 2.

INVENTOR.
LOUIS E. MUELLER
BY Whittemore Hulbert & Belknap
ATTORNEYS

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MAT DRYING APPARATUS

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FIG. 5.

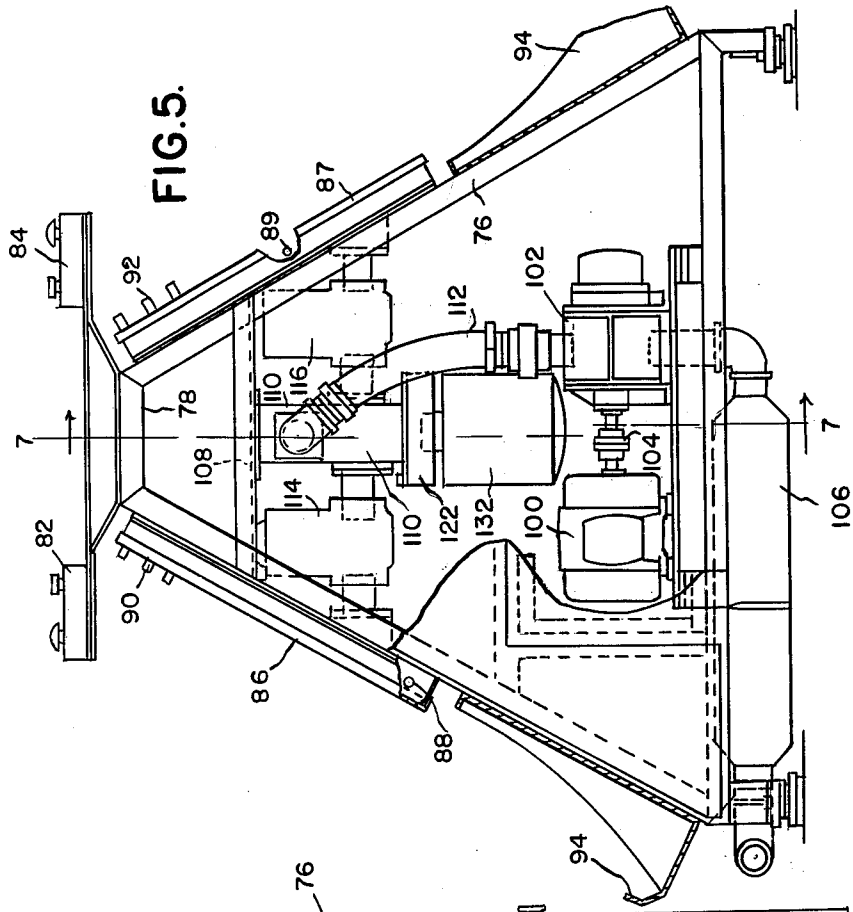
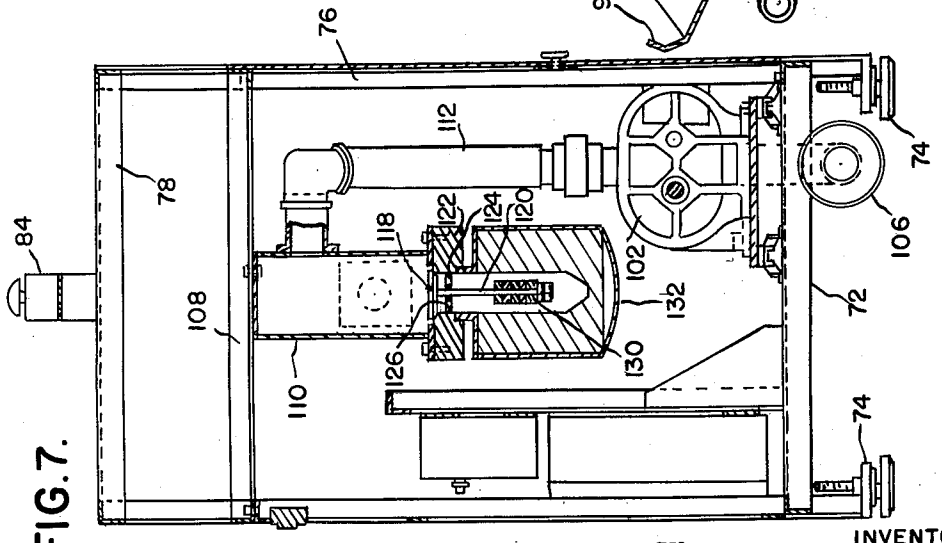


FIG. 7.



INVENTOR
LOUIS E. MUELLER

BY Whittemore, Hulbert & Belknap ATTORNEYS

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MAT DRYING APPARATUS

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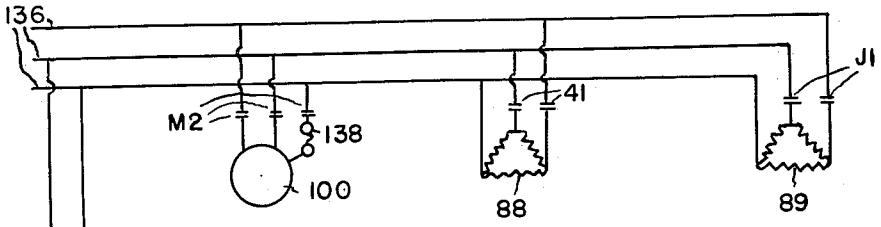


FIG.9.

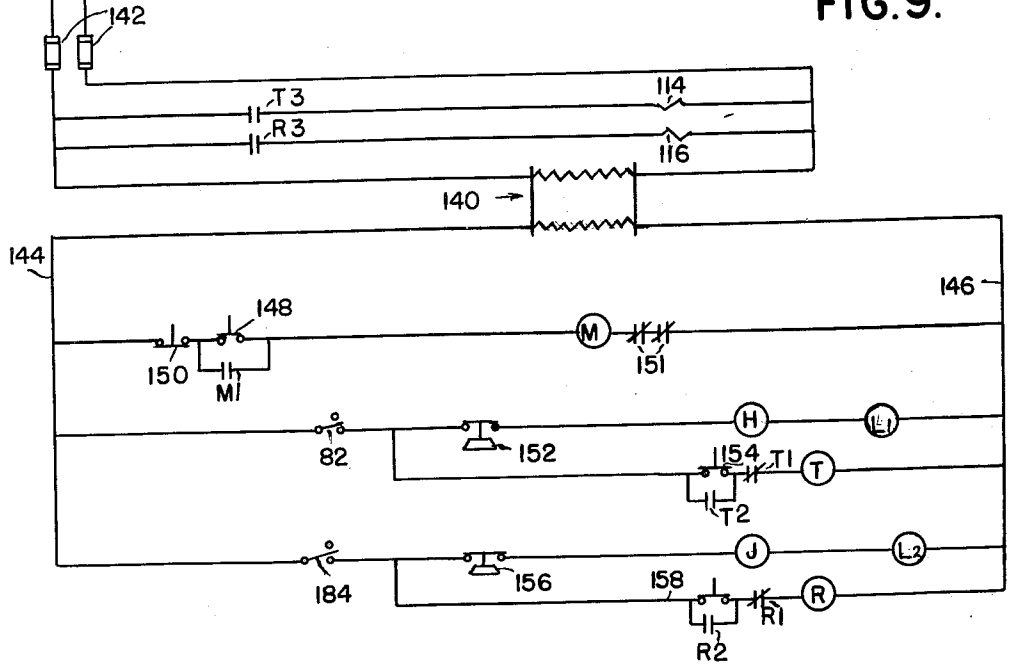
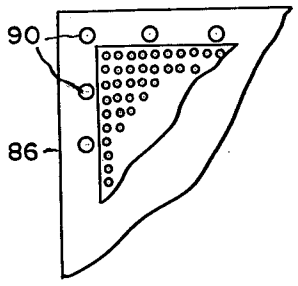


FIG.6.



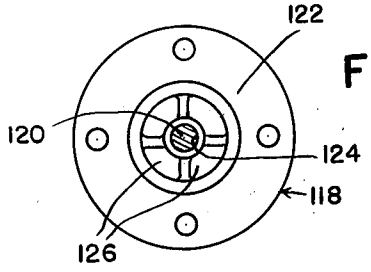


FIG.8.

INVENTOR.
LOUIS E. MUELLER
BY Whittemore, Hulbert & Belknap
ATTORNEYS

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MAT DRYING APPARATUS

Louis E. Mueller, 531 E. Lafayette, Detroit, Mich.

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6 Claims. (Cl. 34—53)

The present invention relates to mat drying apparatus.

In the printing industry papier maché mats are produced having an impression at one side adapted to form a printing impression on a stereotype. This involves casting melted metal onto the mat.

As the mat is initially produced it may have approximately 13% moisture by weight. In the hot press, in which the mat is provided with the stereotype forming impression, some 8% of the moisture content may be eliminated, leaving 5% by weight of moisture in the mat. If the mat with this moisture content were used to cast the stereotype, the relatively great temperature of the stereotype would cause the mat to blow up or become disrupted due to the sudden expansion of the moisture. Accordingly, it is necessary to reduce the moisture content to a low value as for example one percent or less.

This operation has in the past been accomplished by placing the formed mat between heated plates, together with silk or cotton cloth or felt pads interposed to protect the mat. The drying operation under these circumstances required 2½ to 3 minutes and in addition resulted in many cases in some departure of the mat from an absolutely flat article.

In accordance with the present invention the mat in-including a relatively high moisture content and having one surface provided with the designed impression, is supported against a flat rigid perforated support plate and is held against the plate in flat condition by the application of partial vacuum to the rear of the plate. At the same time, the wet mat is heated, the moisture content for the most part escaping from the front surface of the mat. The heat which drives the moisture out of the mat may in some cases be applied externally from the front surface. However, in the preferred embodiment of the invention disclosed herein, the application of heat is through the perforated supporting plate. More specifically, the perforated supporting plate forms a part of an enclosure subjected to partial vacuum, and which enclosure also houses the heating member. Preferably, the heater includes a source of radiant heat which transfers heat by radiation through the perforations of the plate directly into the rear surface of the mat.

With the foregoing general description in mind, it is an object of the present invention to provide a mat drier characterized in the reduction in time required to produce a dried mat, and the ability to produce the dried mat without distortion of the impression forming surfaces or the essential flatness of the mat.

More specifically, it is an object of the present invention to provide a mat drier comprising an enclosure including a flat perforated plate, means for drawing a partial vacuum within the enclosure, and means for heating a wet mat retained against the flat perforated plate by the partial vacuum within the enclosure.

Still more specifically, it is an object of the present invention to provide apparatus as described in the preceding paragraph in which the heating means is located within the enclosure and preferably, comprises means for effecting radiant heating.

Still more specifically, it is an object of the present invention to provide apparatus as described in the preceding paragraph in which the perforated plate is inclined, offset means are provided to receive a mat released from the plate by termination of vacuum, and means for terminating the vacuum to release a dried mat from the plate.

It is a further object of the present invention to provide apparatus as described in the preceding paragraph which comprises automatic timing means for terminating the application of partial vacuum after a predetermined drying interval.

It is a further object of the present invention to provide a method of drying mats which comprises applying differential air pressure to opposite sides of the mat to retain its rear surface against a flat engaging surface, leaving its front surface exposed to provide for free dissipation of moisture therethrough, and heating the plate to expel moisture from its interior while it is retained in flat condition by differential air pressure.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, illustrating a preferred embodiment of the invention, wherein:

FIGURE 1 is a side elevational view of the mat drier;

FIGURE 2 is a plan view of the machine on a slightly enlarged scale;

FIGURE 3 is an enlarged fragmentary end view showing the details of the assembly;

FIGURE 4 is a fragmentary sectional view through a portion of the vacuum distributing system.

FIGURE 5 is a cut-away side elevational view of a further embodiment of this invention;

FIGURE 6 is a partial view of the perforated panel taken from the direction of arrow 6 in FIGURE 5;

FIGURE 7 is a section taken at 7—7 of FIGURE 5;

FIGURE 8 is a view of an air intake disc shown in FIGURE 5; and

FIGURE 9 is a schematic wiring diagram for the embodiment shown in FIGURE 5.

Referring now to the figures, the drier comprises a frame or table 10 having supporting legs 12. Supported upon the table are a pair of inclined drying enclosure assemblies 14 carried by support elements 16 including an upper horizontal portion 18 upon which are mounted the starting switches indicated at 20.

As best seen in FIGURE 3, each of the drying enclosure assemblies 14 includes a flat imperforate rear plate 22, an edge frame 24, and a flat perforated front plate 26 having perforations 28 therein. At the left in FIGURE 3 a mat M is shown in position on the flat perforated supporting plate 26.

Means are provided for heating the mat M while it is retained in flat condition against the supporting plate 26. While this means may comprise external radiant or other type heaters, it is preferred to provide heating members within the enclosures 14. Such heating means are indicated diagrammatically at 30 and may comprise strip heaters or resistance elements encased in metal, or preferably, quartz lamp heaters adapted to operate as radiant heaters. In any case, heating of the wet mat supported by partial vacuum within the enclosures 14 is by heating of the mat while its front surface remains free for the ready movement of moisture therethrough as it is driven off by heating of the interior of the mat.

In a practical embodiment of the invention, the perforated flat plate 26 has a thickness of approximately 1/16 of an inch and is provided with a multiplicity of circular openings having a diameter of approximately 1/16 of an inch and located in regular arrangement with a spacing of approximately 1/16 of an inch between each opening, and the four adjacent openings disposed thereabove. With this arrangement it will be seen that the openings or perforations occupy approximately 20% of the total area of the plate. In general, the total area occupied by the perforations should be between 10 and 50% of the area. It is essential that the plate be absolutely rigid so as to remain perfectly flat when subjected to vacuum. In addi-

tion, the total area and the pattern of the application of partial vacuum to limited areas of the plate must be such as to avoid drawing down the embossed or patterned mat against the flat surface of the plate. Thus, it is necessary to avoid the application of partial vacuum over a relatively large unsupported area of the mat, since this would have the effect of drawing down the forwardly embossed printing areas of the plate.

In order to provide the controlled vacum for supporting the mats against the perforated plates and for retaining them in flat condition, means are provided including an electric motor 32 operatively connected to a vacum pump 34 by suitable means such for example as the driving belt indicated at 36. The pump 34 has a vacuum connection 38 extending to the interior of a manifold 40 (FIGURE 4), the manifold having connections 42 to solenoid actuated valves 44. In order to maintain the operating partial vacuum within the manifold 40 at a uniform value independently of whether one or both of the enclosures 14 is connected thereto, a regulating valve 46 is provided having a light compression spring 48 engaging an adjustable head 50 on the stem 52 of the valve. The arrangement is such that when the reduced pressure within the manifold vacuum 40 falls below a predetermined value, air pressure acting on the exterior of the regulating valve 46 opens the valve sufficiently to permit a flow of air into the manifold to maintain the reduced pressure or partial vacuum at the required value.

Associated with each of the enclosures 14 is a timer 52 each of which is diagrammatically shown as connected to an external source of power by electrical lines 54 extending from a relay box 55 to an outlet 56. The timers are of commercial type and include means 58 for setting a predetermined interval during which the timers, when energized, will maintain the circuit closed through relays contained within the box 55. Extending to solenoids 60 of the solenoid valves 44 from the relay boxes 55 are electrical conductors 62.

The arrangement is such that when a wet preformed mat is placed against one of the perforated supporting plates 26, the operator hits the switch button 20 associated therewith which through the associated timer 52 and relays within the relay box 55, opens the solenoid actuated valve 44 to connect the interior of the enclosure 14 to the source of vacuum through the manifold 40. The heating elements 30 will normally be continuously energized so that the plate 26 is hot and in addition, radiant heat is instantly available to fall upon the exposed portions of the rear surface of the mat through the perforations or openings 28. The timers will be set to maintain vacuum within the enclosures for a predetermined interval as for example 70 seconds. At the end of this interval the solenoid valve closes automatically and the dried mat is removable from the perforated plate.

Preferably, each of the perforated plates has associated therewith mat receiving structure including a tray 64 which may be pivoted to the table at its upper end and retained in the outwardly extended position shown in FIGURE 1 by adjustable braces 66. At the lower ends thereof the trays 64 are provided with outwardly extending flanges 68. It will be observed that the upper end of the trays 64 are offset inwardly so that each of the trays is adapted to receive a series of mats automatically deposited thereon by sliding downwardly from the perforated plate when automatically released from the plate by vacuum. When the upper end of each mat clears the lower edge of the perforated supporting plate, it falls inwardly to a clearance position to provide for downward movement of the subsequently dried mat.

The present invention is characterized in two very important features which contribute to its highly efficient operation. In the first place, drying is accomplished in a much shorter interval than heretofore, possibly due to the fact that one face of the mat is freely exposed so that moisture driven off from the interior of the mat moves freely away therefrom. This is to be contrasted with prior arrangements in which the mat, surrounded by cloth, felt, and the like, has been received between heated plates.

It has been found that surprisingly rapid drying is accomplished with the provision of heating elements within the enclosures, particularly where these heating elements are efficient radiant heaters such for example as quartz rods. The drying interval may further be reduced by associating the source of radiant heat with gold reflectors which have the property of most efficient reflecting infra-red radiation.

Secondly, the invention is characterized in that the mats are dried in an operation which leaves the impressed, embossed, or formed surface out of contact with any material while the plate is nevertheless firmly held against the perfectly flat supporting surface by the application of differential pressure thereto. Thus, distortion of the plate is avoided as well as any possible injury or modification of the accurately formed casting surface 10. Further, the support of the mat against the perforated plate by the differential air pressure applied thereto, has the effect of minimizing shrinkage of the plate during the drying, and further in rendering whatever shrinkage occurs uniform throughout the area of the plate. Thus, the shrinkage, which may be accurately predicted, may be allowed for so that the dried plate may be of extreme accuracy.

In the embodiment shown in FIGURES 5–9, base 72 is supported at each corner by adjustable legs 74. Frame members 76 are inclined inwardly and upwardly from opposite sides of base 72 and are connected by section 78 at their upper ends. Plate 80 is superimposed and section 78 and carriers thereon switching mechanisms 82, 84. Fastened to the upper portions of frame members 76 are perforated plate assemblies 86, 87 which contain heating elements 88, 89 respectively, and which have locating pegs 90, 92 along the sides of an upper corner for receiving and locating a corner of a mat. Placed below each of the perforated plate assemblies 86, 87 is a mat receiving retainer 94, each of which has an upturned outer edge for receiving and retaining dried mats.

Platform 98 is placed on base 72 and fixedly supports motor 100 and vacuum pump 102 which are connected by coupling 104 for driving engagement therebetween. Connected to the exhaust of pump 102 and located beneath base 72 is a muffler 106. Depending from cross member 108, which is fixed between frame members 76, is a manifold 110 which is connected to pump 102 through metal hose 112. Located on either side of manifold 110 are solenoid valves 114, 116 which when open connect manifold 110 respectively with perforated plates 86 and 87.

An air intake is provided in the manifold 110 in the form of a valve assembly having valve 118 with stem 120 and a disc 122 secured to the bottom of manifold 110. Formed centrally in disc 122 is a guide 124 for the stem 120 of the valve 118 which is surrounded by openings 126. Provided centrally along the upper surface of disc 122 is a central beveled opening for receiving the beveled sides of the head of valve 118 in an air-tight seal. Threaded to the lower end of stem 120 are locating nuts 130 which abut against the underside of guide 124, when there is a sufficient vacuum in the manifold 110, to provide a predetermined opening to regulate the vacuum in the manifold 110. Connected to and depending from disc 122 is an air silencer and filter assembly 132 through which all of the incoming air passes.

The circuit diagram for the operation of this embodiment is shown in FIGURE 9. A three-phase, 220 volt, alternating current, electrical power supply is fed to power lines 136 to which are connected pump motor 100 and heating elements 88 and 89. A reset fuse 138 is placed between one of the power lines 136 and motor 100. The primary of transformer 140 is connected

through fuses 142 to one phase of the three-phase power and the secondary of the transformer provides a 110-voltage supply between lines 144, 146 of the secondary circuit. Coils for solenoids 114, 116 are also connected to the one phase of the three-phase power supply.

Relay M is connected between lines 144 and 146 through start button 148, stop button 150, and overload switches 151, and when energized, closes holding contact M–1 and motor contacts M–2.

Relay H is connected between lines 144 and 146 through switch 82, thermostat 152 which is sensitive to the temperature of element 88, and light L–1, and when energized closes contacts H–1 in the circuit for heating element 88. Timer T is connected between power lines 144 and 146 through switch 82, start button 154, contact T–1, and when energized closes hold-in contact T–2 and opens contact T–1 after a predetermined time delay, and closes contact T–3 which energizes solenoid 114.

Relay J is connected between lines 144 and 146 through switch 84, a thermostat 156 which is sensitive to the temperature in element 89, and a light L–2. Lights L–1 and L–2 are placed in a visible location on frame 76. When energized, relay J closes contacts J–1 of heating element 89. A timer relay R is connected between lines 144 and 146 through switch 84, start button 158, and contact R–1, and when energized, opens contact R–1 after a predetermined time delay, closes hold-in contact R–2 and contact R–3 which energizes solenoid 116.

In operation of this embodiment, the motor start button 148 is actuated energizing relay M and starting motor 100 which runs continuously until stop button 150 is pushed or an overload fuse opens. Then either or both of switches 82 and 84 are actuated to energize their respective circuits and since these circuits are similar, only one will be considered. When switch 82 is closed heating element contactor relay H is energized closing contacts H–1 to energize heating element 88. This continues until thermostat 152 opens signifying that the desired temperature in element 88 has been reached, at which time relay H is de-energized. Light L–1 is in the relay support and signifies when power is being applied to the heating element. After a mat has been placed against the locating pegs 90 on perforated plate 86, start button 154 is pushed which energizes relay T closing hold-in contact T–2 and solenoid contacts T–3 and setting in motion timing mechanism, which after a predetermined interval, will open contact T–1 so that vacuum is applied to plate 86 through solenoid 114 to hold the mat against the plate for a predetermined time after which it slides into retainer 94. The timer is adjustable so that different mat drying times are available for each plate assembly.

The drawings and the foregoing specification constitute a description of the improved mat drying apparatus in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. Mat drying apparatus comprising a support, an enclosure mounted on said support, said enclosure including a flat perforated plate inclined at a substantial angle to the horizontal adapted to receive a wet mat thereon, a vacuum manifold, motor and pump means for creating a partial vacuum in said vacuum manifold, valve means connecting said vacuum manifold to said enclosure for creating a partial vacuum therein to hold a wet mat in position flat against the inclined plate with one side of the mat exposed during drying thereof, means operably associated with said pressure manifold to regulate the vacuum therein, radiant heaters within said enclosure operable to heat a mat through said perforations and said plate to dry the mat, and timing means operable to actuate said valve means automatically after a predetermined time to disconnect said vacuum manifold from said enclosure to release said mat from said perforated plate.

2. Mat drying apparatus as claimed in claim 1 and further including means for receiving said mats released from said plate comprising, a tray pivoted at one edge to said support adjacent to and offset inwardly of said enclosure from the bottom of said plate, said tray having a flange at the other edge thereof substantially perpendicular thereto extending in the direction of said plate, and means for securing said tray in an adjusted pivoted position.

3. Mat drying apparatus comprising a supporting frame, a pair of drying enclosure assemblies supported by and inclined inwardly and upwardly from opposite edges of the supporting frame, said drying enclosure assemblies each including an inner and lower imperforate plate, a flat perforated outer and upper plate and means securing the inner and outer plates together to provide vacuum chambers with flat perforated surfaces extending inwardly and upwardly from said opposite edges of the supporting frame adapted to receive wet mats thereon, heating means within each of said vacuum chambers, a vacuum manifold, motor means for producing a predetermined vacuum in said manifold, a vacuum actuated valve in said manifold for limiting said vacuum, conduits extending from said vacuum manifold to each of said vacuum chambers, solenoid actuated valves in each of said conduits for connecting the vacuum chambers to the vacuum manifold for creating a vacuum in said chambers to hold wet mats in position flat against the perforated plates with one side of the mats exposed to produce drying thereof, timing means operably associated with said vacuum producing means, heating means and solenoid actuated valves for timing the operation thereof, a tray secured to said supporting frame below each said drying enclosure assemblies, the trays being substantially parallel to and offset inwardly of the perforated plates of the respective drying enclosure assemblies, and a stop means at the lower edge of said trays extending substantially perpendicularly thereto in the direction of the respective perforated plates.

4. Structure as claimed in claim 3 wherein said timing means is electrical and includes separate heater, motor and solenoid energizing circuits, thermostatic elements in the heater energizing circuits responsive to the temperature of the heaters for maintaining the drying apparatus at a substantially constant temperature, and timing means in the solenoid energizing circuits to automatically de-energize the solenoids a predetermined time after they have been energized whereby the vacuum in the drying enclosure assembles is lost and dried mats are released from the perforated plates.

5. A mat drier comprising a flat, perforated, inclined plate adapted to receive on the upper side thereof a wet mat to be dried, means for establishing a partial vacuum on the lower side of said plate to hold a wet mat received on the upper side thereof flat against said inclined plate during drying thereof with the upper side of said mat exposed to provide for ready removal of moisture therefrom on heating thereof, means for heating a mat on said plate to dry the mat while maintaining the mat flat against said inclined plate and a tray extending below, substantially parallel to, and offset from the lower side of said plate for receiving dried mats released from said plate, and timing means for automatically releasing dried mats from said plate.

6. A mat drier as set forth in claim 5 wherein said means for heating said mat is positioned adjacent the lower side of said plate whereby moisture from said mat moves freely away from the exposed surface of the mat on heating thereof thereby reducing the time required for the drying of the mat.

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