Feb. 18, 1958 W. LUDIN ET AL 2,823,742

PROCESS FOR DRYING SLIME, PARTICULARLY FOUL SLIME, AND PLANT FOR EXECUTING THE SAID PROCESS

Filed Aug. 13, 1951 3 Sheets-Sheet 1

Fig. 1

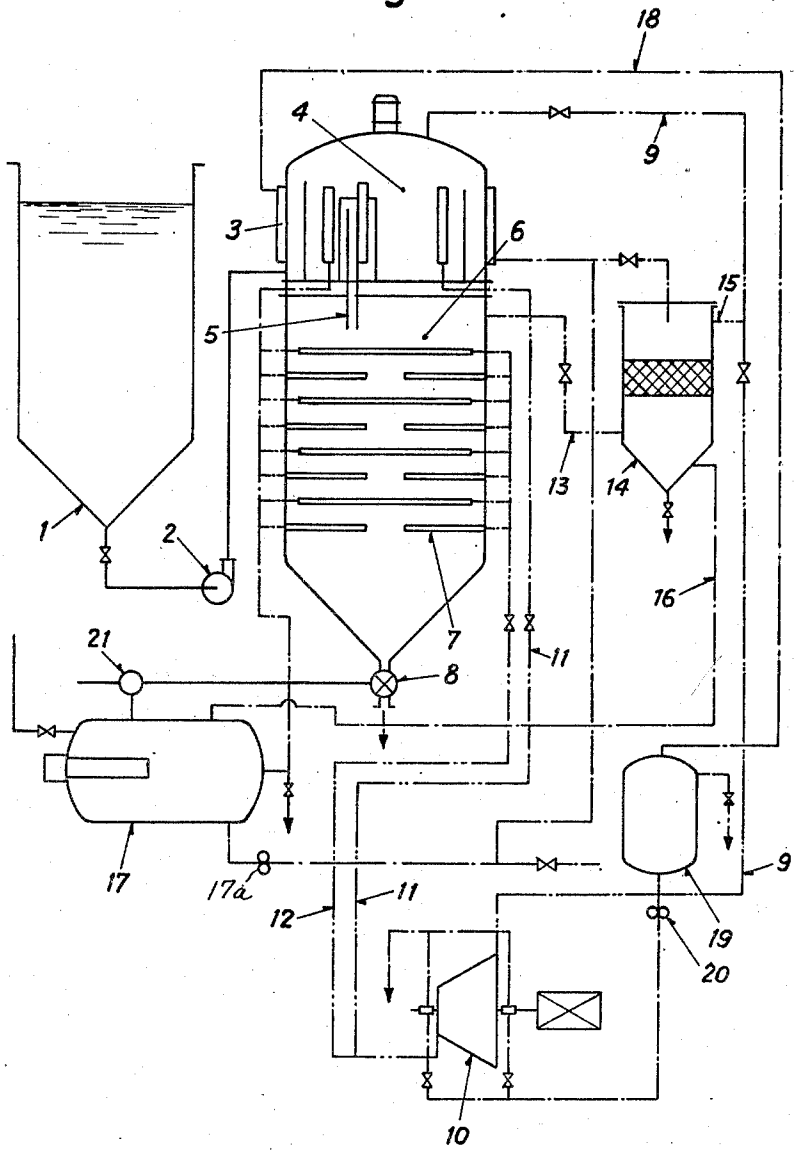

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Fig. 2

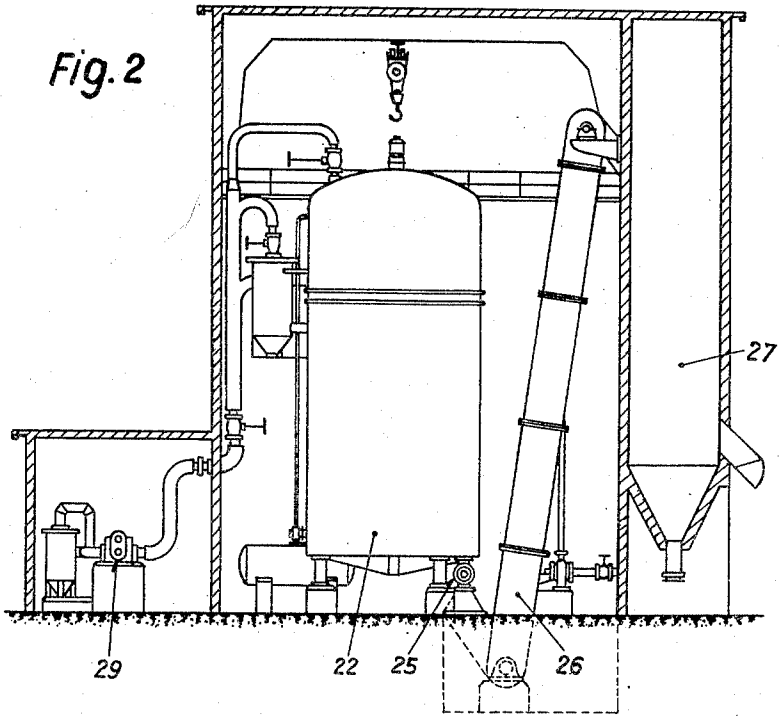

Fig. 3

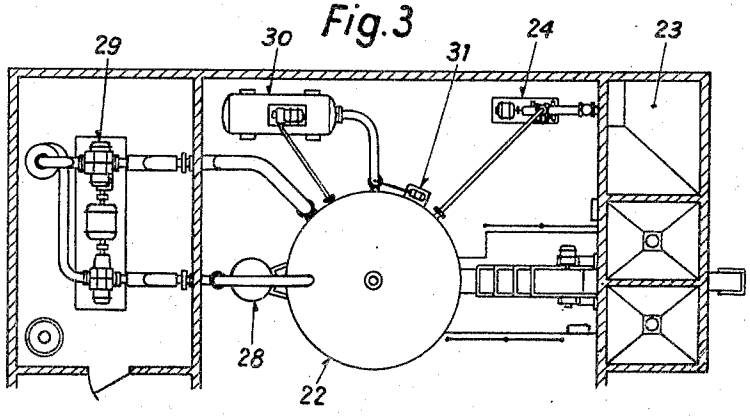

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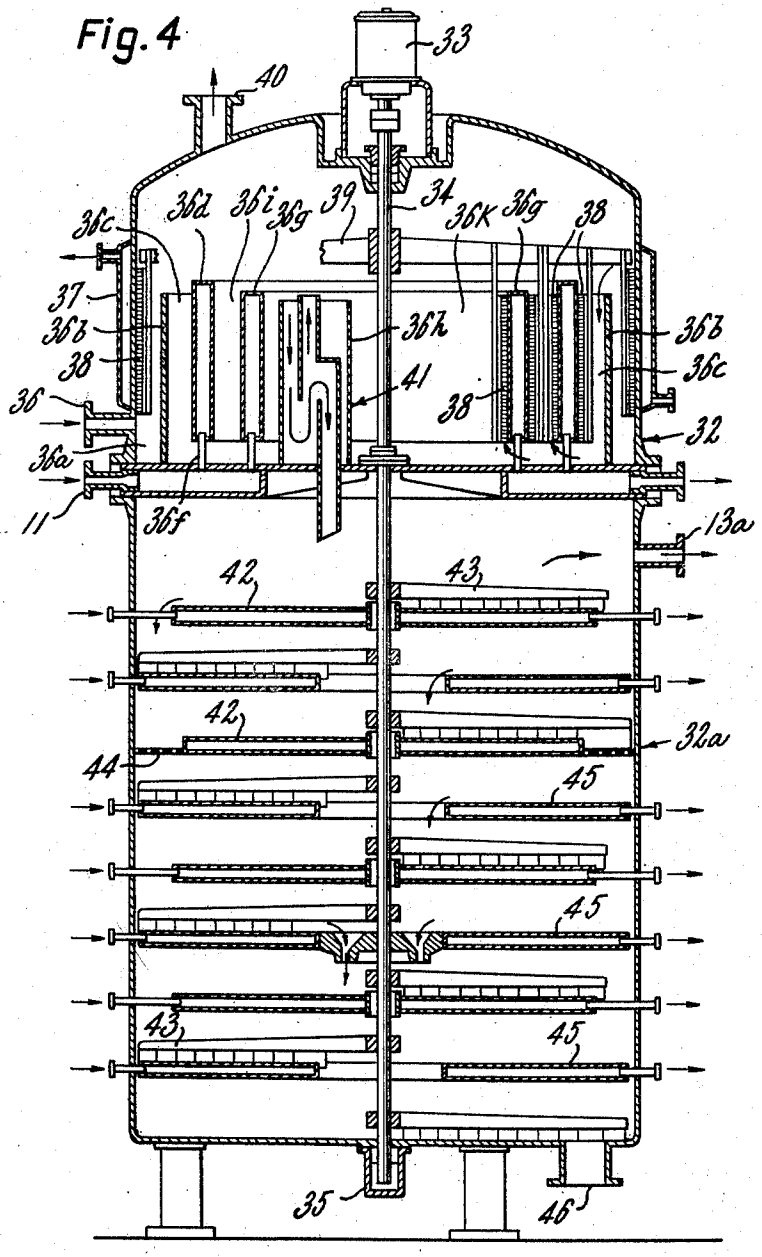
Fig. 4



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2,823,742

PROCESS FOR DRYING SLIME, PARTICULARLY FOUL SLIME, AND PLANT FOR EXECUTING THE SAID PROCESS

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5 Claims. (Cl. 159—24)

The drying of plastic materials such as slimes, particularly foul slime, causes considerable technical difficulties, since materials of this type tend to form clods and to stick to the heating walls, stirring devices and the like. The clod formation can prevent the equal and uniform drying of the material and always causes a retardation of the drying process.

To avoid these difficulties it has been suggested that the drying be effected in several stages and that for each stage a special device should be used. Thus, it was suggested that a drum dryer be used for the first stage where the material is still in a liquid state and that in the second stage a plate or band dryer be used which will then be more suitable for plastic materials. However, even with this combined drying system, which employs several dryers, clod formation could not be prevented and fast and uniform drying of the material was not posible. Furthermore, dryers of this kind are not only very bulky but also very expensive.

For vacuum drying of plastic materials, it has also been proposed to ventilate the dryer at certain time intervals, whereby an increase in temperature is caused in the materials to be dried. In certain materials the subsequent vacuum period can effect the dissolution of clods due to the momentary vapour development inside the material.

An advance in drying technique was recorded due to fact, that the material is given shape after a certain initial drying, whereupon the thus obtained shaped pieces will be further dried. After short drying, the pieces retain their shape and can then be further dried in other dryers until they are completely dry. With this apparatus the difficulty of the sticking of the material to the drying devices is eliminated. However, this apparatus is also very expensive as it consists of several separately arranged drying devices which are connected with each other by conveyor belts.

The present invention is directed to a process and a drying device for drying slime, particularly foul slime, in which all the equipment necessary for the drying process is grouped together and in which particular care is taken for best utilization of the heat supplied. Therefore, the drying plant is much simpler in construction and considerably less expensive to build than other known plants. Furthermore, the space required is for such drying plant and equipment much smaller which is also an important advantage.

The process for drying slime, particularly foul slime, in which the slime to be dried is fed by means of a pump for viscid materials from a reservoir first to a pre-heater and then to several heated devices is characterized in that the vapours originating in the evaporator of the plant are directly led to a compressor and the vapours originating in the dryer of the plant are led to the compressor via a washer, the vapors being then pressed into the evaporator and the plates contained in the dryer for heating the same, whereby at least the condensate originating in the evaporator is fed to the

stuffing boxes of the compressor for cooling and lubricating the same, and that in the evaporator as well as in the dryer the slime is moved by rotating brushes and scrapers and that at least after that drying stage after which the slime tends to form clods, the slime is divided into parts or strips e. g. rods of small cross-section for further drying.

The slime drying plant for executing the process consists of a reservoir for the slime, a pre-heater, an evaporator and a dryer consisting of several heated devices, a pump for viscid material for feeding the slime from the reservoir to the pre-heater and means for heating the pre-heater, the evaporator and dryer and is characterized in that at least after that heated device in which the drying process of the slime has progressed so far that the slime coagulates or has the tendency to stick and form clods, means are provided for dividing the slime in preshaped parts, such as rods of small cross-section.

In the accompanying drawings, an example of a slime drying plane in accordance with the present invention is shown. In the drawings:

Fig. 1 is a diagrammatic view of the arrangement of the components of the drying plant,

Fig. 2 is an elevational view partly in section of a drying plant according to the invention,

Fig. 3 is a plan view of Fig. 2,

Fig. 4 is a partial section of parts of the drying equipment proper employed in said drying plant.

Fig. 1 is a diagrammatic view of the arrangement of the drying plant in which **1** designates the reservoir for furnishing the foul slime. From this reservoir the foul slime passes through the pump **2** for viscid material to the pre-heater **3**. The pre-heater **3** is followed by the evaporator **4** from which slime is fed to the plate dryer **6** through duct **5**. This plate dryer is only shown diagrammatically, as the drive members of the plate dryer are not shown. All the plates **7** of the dryer are heated in any suitable manner. The slime passes from one plate to the next one and at last, when it is dry, leaves the dryer through the lock **8** in the direction of the arrow. Hot vapours are formed in the evaporator **4** which are led from the uppermost region thereof to a compressor **10** through a duct **9** indicated by dot-and-dash lines. In the compressor the hot vapours are compressed whereby their temperature is increased. The vapours are then lead and distributed, through the ducts **11** and **12** shown by double dot-and-dash lines, to the evaporator **4** and to the plates **7**. The vapours originating in the dryer **6** are fed from the uppermost region thereof to a washer **14** through a duct **13**. From the washer the vapours pass through a duct **15** into the duct **9** leading to the compressor **10**. The condensate leaves the washer **14** through the duct **16** and is led into a tank **17** where it is collected and from which it is fed, by means of a pump **17***a*, to the pre-heater **3** and to the vapour washer **14**, respectively. The condensate from the pre-heater passes through the duct **18** (dot-and-dash line) to the tank **19** and is fed to the stuffing boxes of the compressor **10** by means of a pump **20**. After having served for cooling and lubricating there, the condensate leaves the system. Finally, a water ring pump **21** is provided for removing gases which have not condensated and, if necessary, air from the intake lock **8** of the dryer.

This short description of the arrangement of the slime drying plant shows already that maximum utilization of the available heat is effected by the arrangement of the gas passages. Figs. 2 and 3 show the actual construction of the drying plant. The dryer which is arranged centrally is designated by **22**. From the slime reservoir **23** the slime is fed, by the pump **24** for viscid materials, to the dryer **22**, i. e. to the pre-heater, as can be seen in the

diagrammatic view in Fig. 1. The dried material leaves the dryer through the lock **25** and is then fed to a reservoir for dried slime **27** by means of a bucket conveyor **26**. The two-stage compressor unit for compressing the vapours removed from the evaporator through the duct **28** is designated as **29**. The condensate container is designated by **30**, the vacuum pump by **31**.

Fig. 4 shows the construction of the actual dryer. The latter consists of a casing **32**, preferably of cylindrical shape, in which a motor **33** is mounted at the upper end. The motor **33** drives a central shaft **34** which rests in a bearing **35** at the lower end of the casing **32**. This central shaft **34** carries a lever **39** to which brushes **38** are fastened for moving the foul slime.

In operation, the slime is introduced into the dryer through an intake duct **36** and into the annular channel **36*a*** between the wall of casing **32** and a first wall **36*b***. The channel **36*a*** is located adjacent the preheater **37** and thus defines the preheating zone.

Upon filling of annular channel **36*a***, the slime overflows into an annular channel **36*c*** formed by and between the wall **36*b*** and the first annular heater body or element **36*d***. The heater body **36*d*** is connected to the conduit **11** leading from the compressor, e. g. **10** (see Fig. 1), by means of about tweleve circumferentially spaced pipes **36*f***. The body or element **36*d*** is fixedly supported by these pipes **36*f*** so that beneath the lower edge of said element **36*d*** there remains a flow passageway for the slime. The upper edge of the annular body or element **36*d*** is located at a somewhat higher level than the upper edge of the wall **36*b*** to ensure that the slime will always first flow directly into the annular channel **36*c***.

The slime is now divided and flows through the two channels **36*i*** and **36*k*** formed, respectively, by and between the first heater body **36*d*** and the second annular heater body or element **36*g*** and by and between said second heater body **36*g*** and the wall **36*h*** of the outflow duct or channel **41**. In order to assure continuous flow of the slime through the duct **41** and to prevent any possible damming up of the slime, the upper edge of the wall **36*h*** is disposed at a lower level than the upper edge of the annular body **36*g***.

The two annular heater bodies or elements **36*d*** and **36*g*** and the channels **36*c***, **36*i*** and **36*k*** thus will be seen to constitute the evaporator portion or zone of the dryer. The hot vapors which emanate from the slime in the evaporator zone are exhausted from the latter through outlets **40**. The preheater **37** (3 in Fig. 1) and the evaporator **36*c*—*d*—*g*—*i*—*k*** (4 in Fig. 1) together constitute preliminary heating means.

As may be seen from Fig. 4, the brushes **38**, which rotate with the shaft **34**, continually keep the slime within each of the annular channels, i. e., in the preheating and evaporator zones, in motion and thus prevent caking thereof on the surfaces of casing **32**, insulating wall **36*b***, and heater bodies or elements **36*d*** and **36*g***. The slime, after passing through duct **41** reaches the plate drying means, i. e., the final heating means. A number of scrapers or brushes **43** which are also driven by the central shaft **34** traverse the plate dryers **42**. In Fig. 4, a ring-shaped sieve **44** is shown at the third plate dryer through which the slime is pressed. Thereby the slime is divided into individual parts in the form of strips or rods of small cross-section and, in this form, reaches the next plate **45**. In the subsequent stages or plates **45** the rods having small cross-sections are completely dried and crumbled, additional brushes **43** being provided for the plates **45** to aid in this process. The crumbled rods then pass, through the lock **46**, to the bucket conveyor by which they are moved to the container for dried material. All the plate dryers are, of course, hollow and are heated by vapors coming from the condenser **10** through ducts **12**.

The sieve **44** is suitably arranged after the plate where the material to be dried has reached a state in which it tends to form clods. It is known that the material cannot be dried after it has formed clods since the surface is then too small and only a small layer of the clod dries. Due to the division in parts or strips of small cross-section the clod formation is either entirely prevented or, if clods have already formed, the disadvantage of clod formation is at least eliminated. Since not all substances tend to form clods at the same stage it is not possible to state exactly after which plate the sieve must be installed. However, the general arrangement of the dryer permits the installation of the sieve at any position. Therefore, the plant can be used not only for a certain slime but for many kinds of material in plastic state. Vapors collected in the lower part **32*a*** of casing **32** may escape through a conduit **13*a*** as indicated, which corresponds to conduit **13** of Fig. 1.

As shown by the embodiment of the drying plant, all the components necessary for the drying process are assembled together in one simple dryer. Apart from this, auxiliary components or devices are provided which cooperate with the dryer in such manner that maximum utilization of the heat is effected. In the operation of the plant a temperature increase of 20° on compressing the hot vapours has proved suitable. It is also advantageous to operate the dryer with a light vacuum. However, these values are only examples. Depending on the properties of the material to be dried other temperature increases and other pressure conditions in the dryer may be more suitable.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a drying plant for treating slime and like viscid mass; an upright casing having an upper part and a lower part, transverse partition means fixed in said casing and separating said upper and lower parts thereof, a motor-driven rotatable shaft extending substantially centrally through said partition means and said upper and lower parts of said casing, first duct means communicating with the interior of said upper part of said casing adjacent and above said partition means and defining an intake for admitting said mass into the lowermost region of said upper part of said casing, a substantially cylindrical preheater located exteriorly of and surrounding said upper part of said casing, a first substantially cylindrical body mounted on said partition means interiorly of said upper part of said casing and disposed concentrically about said shaft, at least one second substantially cylindrical heating body located within said upper part of said casing and disposed concentrically about said shaft and between the latter and said first body, said heating body being vertically spaced from said partition means, whereby a tortuous up-and-down flow path for said mass from said first duct means and through said upper part of said casing is defined by said first and second bodies, the latter together with said preheater constituting preliminary heating means for said mass, brushing means carried by said shaft in said upper part of said casing and contacting the vertical surfaces of said second body for moving said mass past the same upon rotation of said shaft as said mass is partly dried, a plurality of vertically spaced plate drying means arranged concentrically about said shaft in said lower part of said casing below said partition means, each of said plate drying means being provided with at least one aperture extending therethrough, second duct means extending through said partition means at a location between said heating body and said shaft for discharging said partly dried mass onto the uppermost one of said plate drying means, respective scraper means carried by said shaft for rotation therewith and extending over and in contact with said plate drying means to effect movement of said partly dried mass over each plate drying means to the aperture therein, thus causing said mass to fall from each plate drying means to the next lower plate drying means and in the direction of the bottom of said casing, sieve means covering said aperture

of at least one intermediate plate drying means, whereby said partly dried mass upon passage from said intermediate plate drying means to the next lower one is divided into strip-like formations to facilitate drying thereof on those of said plate drying means beneath said sieve means as well as crumbling of said mass by said scraper means associated with said last-named plate drying means, and outlet means in said lower part of said casing for receiving said mass in substantially fully dried and crumbled state from the lowest of said plate drying means.

2. In a drying plant according to claim 1; at least one additional substantially cylindrical heating body located between said first-named heating body and said shaft and concentrically about the latter, said second duct means being located between said shaft and said additional heating body.

3. In a drying plant according to claim 2; a compressor, means communicating with said upper part of said casing and with the suction side of said compressor for conducting to said compressor vapors liberated from said mass due to operation of said preliminary heating means, whereby said vapors are compressed in said compressor and their temperature raised, and further means communicating with the pressure side of said compressor and with said heating bodies and with said plate drying means for distributing said compressed vapors to said heating bodies and to said plate drying means, respectively, to heat the same.

4. In a drying plant for treating slime and like viscid mass; an upright casing having an upper part and a lower part and a bottom for said lower part, transverse partition means fixed in said casing and separating said upper and lower parts thereof, a motor-driven rotatable shaft extending substantially centrally through said partition means and said upper and lower parts of said casing, means communicating with said upper part of said casing at a location a short distance above said partition means and defining an intake for admitting said mass into the lowermost region of said upper part of said casing, an annular preheater located exteriorly of and surrounding said upper part of said casing substantially coaxially with the latter, a first annular body mounted on said partition means interiorly of said casing and about said shaft, at least one second annular heating body located within said upper part of said casing about said shaft, said heating body being spaced from said partition means and arranged between said shaft and said first body, whereby a tortuous up-and-down flow path for said mass through said upper part of said casing is defined by said first and second bodies, brushing means carried by said shaft in said upper part of said casing and contacting said second body for moving said mass past the same upon rotation of said shaft as said mass is partly dried, said bottom being provided with an outlet opening, a plurality of vertically spaced plate drying means arranged in said lower part of said casing below said partition means and each provided with at least one aperture extending therethrough, overflow-type duct means extending through said partition means at a location between said shaft and said heating body for discharging said partly dried mass onto the uppermost one of said plate drying means, respective scraper means carried by said shaft for rotation with the latter and extending over and in contact with said plate drying means and said bottom to effect movement of said mass over each plate drying means to the aperture therein and over said bottom to said outlet opening, thus causing said mass to fall from each plate drying means to the next lower plate drying means and from the lowest one of said plate drying means onto said bottom of said casing and from said bottom through said outlet opening, and sieve means covering said aperture of at least one of said plate drying means above said lowest plate drying means, whereby said partly dried mass upon passage through said sieve means is divided into strip-like formations to facilitate drying thereof on those of said plate drying means beneath said sieve means as well as crumbling and granulating of said mass by said scraper means associated with said last-named plate drying means, whereby said mass is received on said bottom of said casing in substantially fully dried and crumbled state from said lowest of said plate drying means.

5. In a drying plant according to claim 4; a compressor having a pressure side and a suction side, said heating body and said plate drying means being provided with hollow interiors, first means establishing communication between the uppermost region of said upper part of said casing and said suction side of said compressor, second means including vapor washer means establishing communication between the uppermost region of said lower part of said casing and said suction side of said compressor, and third means establishing communication between said pressure side of said compressor and said hollow interiors of said heating body and said plate drying means, respectively, whereby vapors liberated from said mass in said upper and lower parts of said casing are led, respectively, directly to said compressor through said first means and directly to said washer means and thence to said compressor through said second means, said vapors being compressed and their temperature raised in said compressor and thereafter being distributed through said third means to said heating body and said plate drying means for heating the same.

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