

[54] **CASEIN OR THE LIKE DRYING MACHINES**

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[22] **Filed: Dec. 7, 1970**

[21] **Appl. No.: 95,688**

[52] **U.S. Cl. ....34/173, 34/182, 34/211**

[51] **Int. Cl. ....F26b 11/12**

[58] **Field of Search.....34/173, 182, 185, 34/211; 263/26; 110/15; 99/246**

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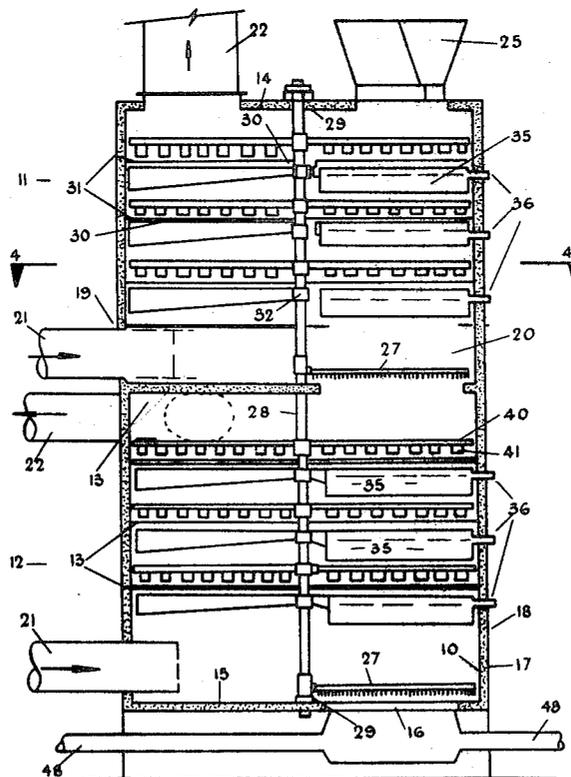
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[57] **ABSTRACT**

A casein drying machine has a pair of vertically superposed chambers, the upper feeding to the lower. Gaseous drying medium is fed to the bottom of each chamber, Screens with non-registering openings are superposed in each chamber and scrapers rotating about a central vertical axis sweep the screens so that the drying casein moves from top to bottom of the apparatus along a circuitous path including a plurality of gravity falls.

**3 Claims, 13 Drawing Figures**



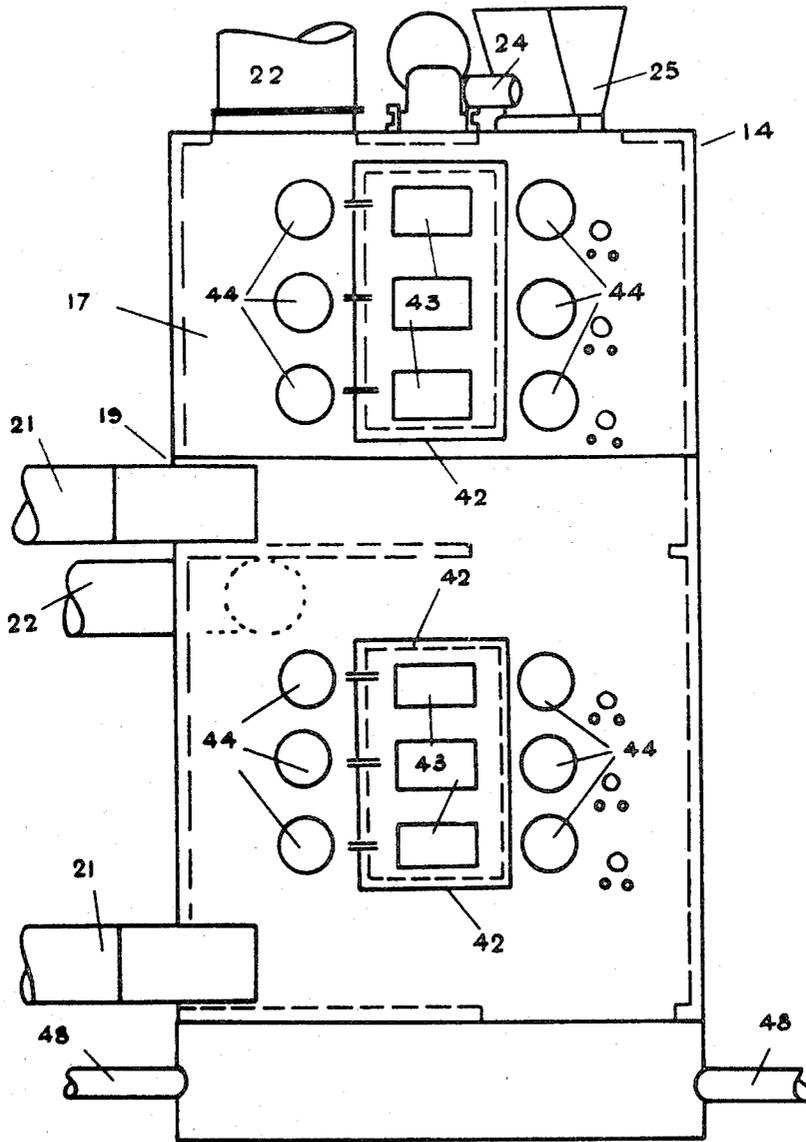


FIG. 1

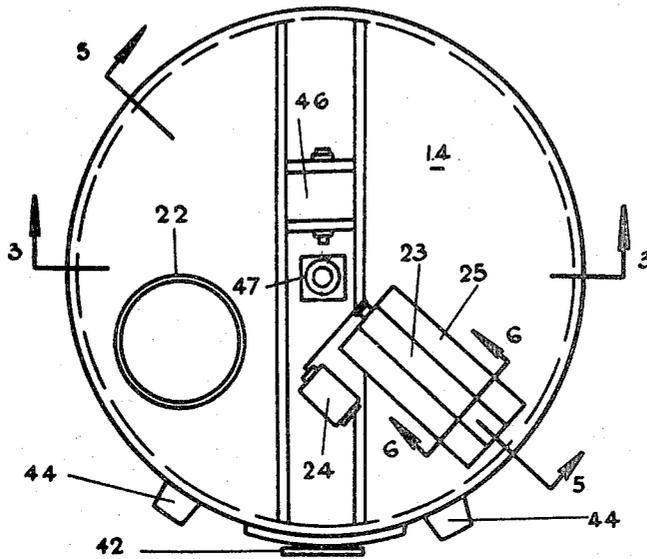


FIG. 2

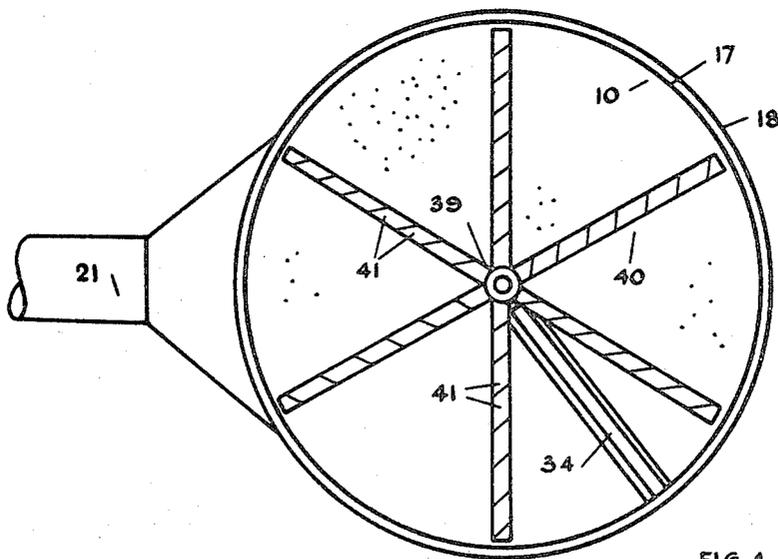


FIG. 4

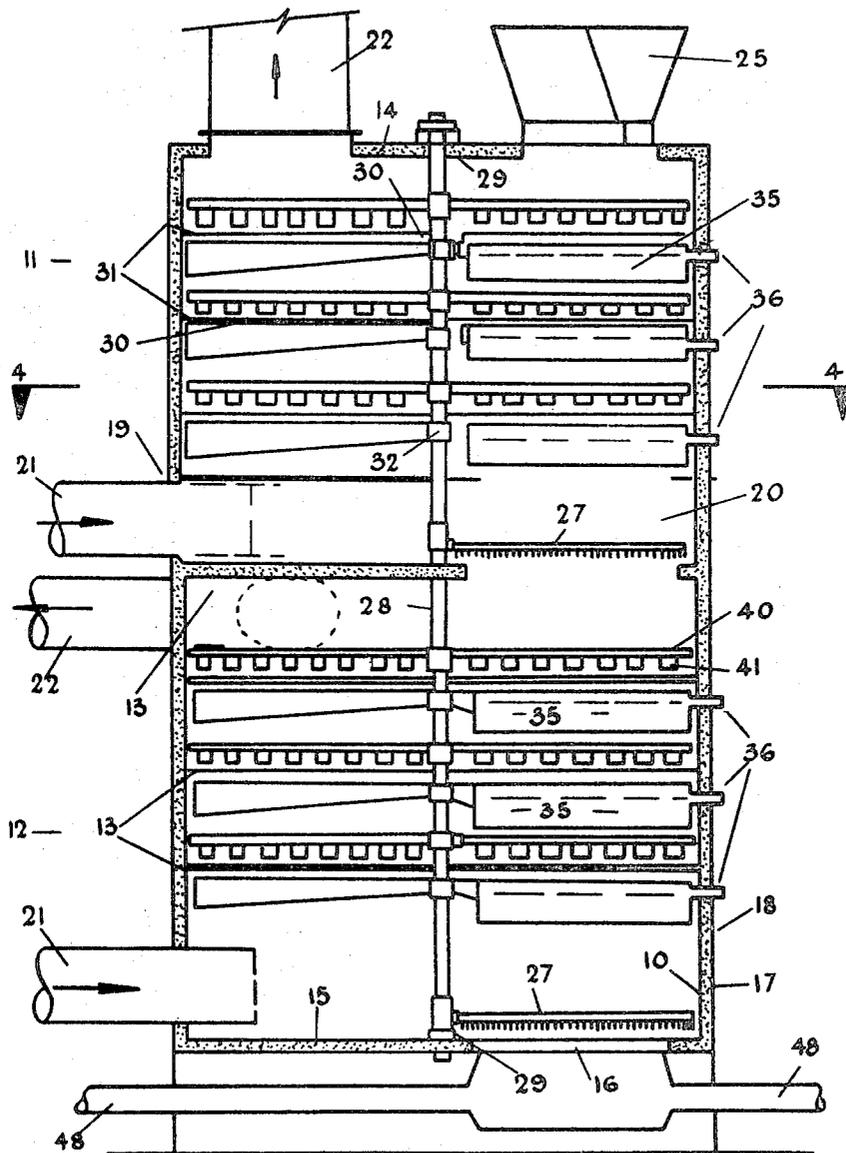


FIG. 3

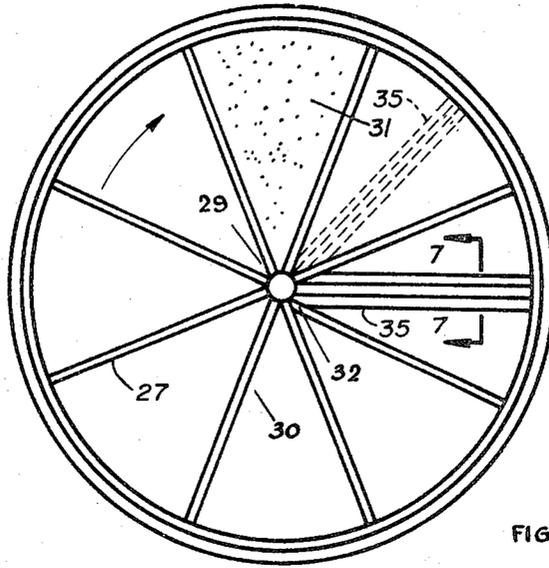


FIG. 5

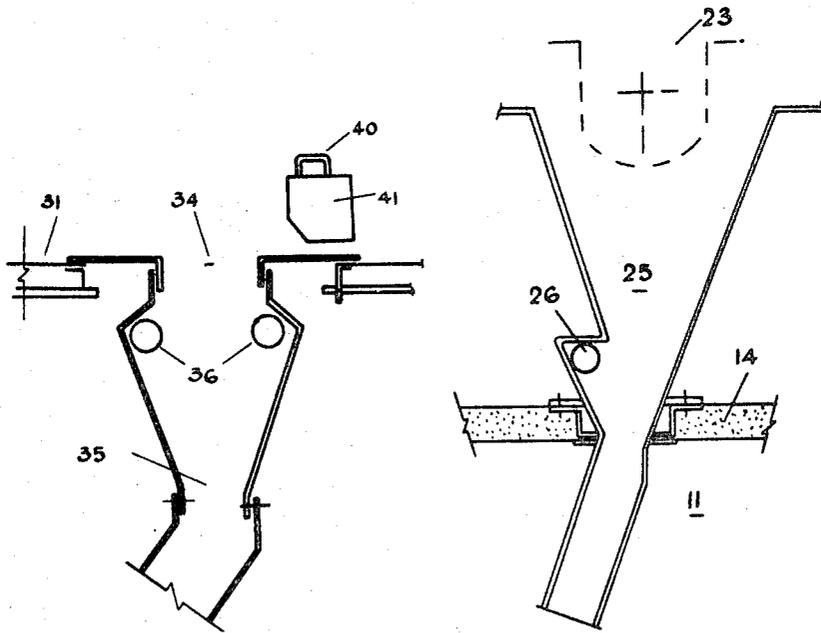


FIG. 7

FIG. 6



**CASEIN OR THE LIKE DRYING MACHINES**

This invention relates to improvements in machines designed for use in the drying of materials such as casein.

This type of machine is well-known and in the past years has taken on several forms. For instance, machines employing an endless belt passing sets of rollers for expressing the moisture from the curd or casein have been found to be not very efficient, often resulting in a not properly treated product.

The present invention is concerned with a casein or the like drying machine having such a construction and/or arrangement of its parts, that the machine is very effective in properly drying the material to the desired effect.

Generally the invention consists of a casein or the like drying machine comprising a vertical cylinder divided into two separate chambers, an upper one of the chambers having an upper feed inlet and a lower feed outlet communicating with a lower one of the chambers providing an upper feed inlet to the lower chamber which also has a lower feed outlet, each chamber having a lower gaseous drying medium inlet, an upper gaseous drying medium outlet, apertured screens fixed at different levels in the height of each chamber but leaving a gap for a gap in a lower screen out of register with a gap in an upper screen, a vertical shaft extending through both chambers and journaled in the ends of each chamber, scraper members attached to the shaft for each member to be positioned adjacent the upper side of the particular screen, and a drive means connected to the shaft, the construction and arrangement being such that upon wet casein being inserted into the upper chamber through its upper feed inlet with the shaft and its scraper members being caused to rotate by its drive means and with a gaseous medium being passed into the upper chamber through the lower inlet therefor into this chamber, the wet casein will first fall onto the uppermost screen and there be moved until it falls through the gap in such screen onto the next screen where it is similarly treated and so on, until it passes through the gap of the lowermost screen, the casein during its progress down through the upper chamber being continuously and progressively dried by the up-moving gaseous drying medium which ultimately passes through the upper outlet of the upper chamber in a moisture laden state; the casein discharges through the lower outlet of the upper chamber and through the upper feed inlet into the lower chamber where the casein is similarly treated by the screens in this chamber to be continuously and progressively further dried by up-moving from the lower inlet therefor of this lower chamber, this gaseous drying medium ultimately passing through the upper outlet of this lower chamber in a moisture laden state.

In further describing the construction and function of the invention, reference will be made hereinafter to the accompanying drawings, in which:

FIG. 1 is an elevation of the machine,

FIG. 2 is a plan on the cylinder,

FIG. 3 is a sectional elevation of the machine,

FIG. 4 is a cross-section taken on the line 4—4 in FIG. 3,

FIG. 5 is a cross-section showing a typical spider member,

FIG. 6 is an enlarged cross-section taken on the line 6—6 in FIG. 2 and

FIG. 7 is an enlarged cross-section taken on the line 7—7 in FIG. 5.

FIG. 8 is an enlarged side view of a typical trough or chute with an air pipe,

FIG. 9 is a view taken on the line 9—9 in FIG. 8 showing one cross-section of the trough or chute,

FIG. 10 is a similar view showing another cross-section of the trough or chute and

FIG. 11 is a plan of the trough or chute on a different scale,

FIG. 12 is a perspective view of one form of the air pipe, and

FIG. 13 includes perspective views of another form of the air pipe.

In giving effect to the invention the vertical cylinder 10 is one of predetermined size or capacity and is divided internally into the two chambers 11, 12 by a horizontal baffle or wall 13 which is especially formed so as to afford that both chambers are air-sealed from one another.

The top of the cylinder 10 is closed by an end plate 14 whilst near the bottom of the cylinder is a bottom wall 15 provided with the lower material or casein outlet 16 of the machine. The total external peripheral surface of the cylinder 10 excepting inlets and outlets, access doors and drive connections shortly referred to, is covered by suitable insulation 17 such as sponge plastics material, rubber or the like. In order to properly contain the insulation an outer peripheral wall 18 is provided consisting of two shells halves or parts, one being fitted to the other. The upper end has two inner angle flanges (not shown) between which is fitted a gasket providing a joint seal 19. A further upper horizontal sealing wall can be provided a distance apart so as to take the gaseous drying medium inlet of the upper chamber 11 and in this instance a secondary inlet is provided in this wall to the upper chamber. Due to this spacing between the two internal horizontal walls 13, 19, a short duct 20 extends vertically connecting the material lower outlet of the upper chamber 11 and the material top inlet of the lower chamber 12.

The inlet 21 for the drying medium for each chamber 11 or 12 consists of a large duct connection located through the composite peripheral side wall and the outlet 22 for such medium also consists of a large duct connection passing through such composite wall near the top end of such chamber 11 or 12. The casein feed inlet to the upper chamber 11 can include a mincer 23 operated by the drive means or a separate motor 24 with a hopper 25 located below the mincer. This inlet includes an air pipe 26 adapted for connection to a lead from a header (not shown) of separate high pressure air fan or air pump. At the material outlet of each chamber (11 or 12) for the drying or dried casein there is also included a wiper arm 27 mounted to extend radially from the center shaft 28. In an alternative this inlet can include a small rotary valve adapted to be driven by the drive means; and at the material outlet of the lower chamber 12 for the dried casein there can also be included a small rotary valve (not shown) adapted to be driven by the drive means.

Located at the center of the ends of the cylinder 10 are bearings 29 which journal the vertical central shaft 28 mounting the scraper members.

Each chamber 11 or 12 is divided internally into a number of separate compartments dependent upon a plurality of spiders 30 employed. These spiders are

fixed at the different levels to mount the screens 31, which cover the spiders. Desirably there are three separate compartments, the division in each case being effected by one of the apertured screens 31 that is of a very fine mesh in stainless steel. Each screen 31 is supported by its particular spider 30 which in turn is suitably supported by the peripheral wall of the cylinder 10.

Each of the three spiders 30 consists of a hub 32 through which the central shaft 28 freely passes and rotates and from which hub 32 radiate a plurality of arms 33, such as six arms. The segmental space between two of these arms is covered by part of the fine screen mesh 31. In the screen part is provided a gap such as a slot 34 that extends substantially the radius of the screen.

This slot 34 is connected to act as an inlet to a trough or chute 35 (of various cross-section) in which is located at least one air pipe 36 for distributing air downward to an outlet side of the trough or chute. Both the chute and pipe extend the length or substantially the length of the slot 34 in the screen 31. Each air pipe has a series of holes 37, a slot 38 or spray nozzles (not shown) and has one end adapted for connection to a lead from the air fan or pump header. This will ensure that air from each pipe 36 will be directed within the trough or chute 35 to form a greater pressure at the discharge end of the trough or chute than opposed upwardly directed drying air in the particular chamber.

The declining chute is out of register with the slot 34 in the next lower fixed screen 31, but the outlet of the chute of the lowermost fixed screen of the particular chamber is directly above the lower outlet 16 of such chamber 12. Instead of each air pipe 36 a small rotary valve (not shown) may be located in the respective chute 35 and adapted to be driven by the drive means. This valve can include a rotor consisting of two plates each of angle cross-section arranged heel-to-heel and welded so that there are four arms radiating from the center of the rotor and being closed by plates welded to the ends of such arms.

The scraper members according to this embodiment is also six in number, one associated with each particular screen 31 of the respective chamber. Each member consists of a collar 39 having a fixing means by which the collar is attached to the vertical drive shaft 28. From this collar 39 radiate a number of arms 40; to each is mounted a series of scraper or raking blades 41 that are set at an angle, relative to the longitudinal axis of the particular arm 40. The scraper member is mounted on the drive shaft 28 at a level so that the bottom edge of its scraper blades 41 are just above, such as about  $\frac{1}{8}$  -  $\frac{3}{8}$  inch above the surface of the associated fixed screen 31. Opposite the screens (31) of each chamber 11 or 12 the wall of the cylinder 10 is provided with an access door 42 with sight glasses 43 and preferably lights 44. The peripheral edge of the door is backed by a sponge rubber seal 45.

The drive means includes a motor 46 preferably located in a housing mounted on the top end plate 14 of the cylinder 10 and a reduction gear 47 the output shaft of which is coupled to the vertical shaft 28. Sprockets and endless chains (not shown) are arranged to drive the rotary valves of the casein feed inlet, such outlet and those of the discharge slots of the particular screen compartments of both chambers.

In use with the machine power driven, heated gaseous medium, i.e. hot air is forced in through the lower

air duct 21 of the upper chamber 11 and lower heated air is forced in through the lower air duct 21 of the lower chamber 12. The casein in its moist state, wet casein, that is casein at a moisture of approximately 55 percent is introduced via the hopper 25 and its mincer 23 (if included) in through the top feed inlet of the upper chamber 11 onto its top fixed screen 31. The angled blades 41 of the top scraper member 40 progressively move the casein around the screen in a circular pattern with a weaving motion until the casein reaches the discharge slot 34 of that screen 31. Air from each air pipe 36 below this slot now forces the casein down to the next screen 31, and so the casein falls to the next stage where repetition of the operation in the first stage takes place. This air from each pipe 36 forms an air-lock by preventing the hot air, used for drying, passing up through the particular trough or chute 35 and forming the greater pressure at the discharge end of such trough than the opposed drying air. This operation takes place for the third stage in the upper chamber 11, when the drying casein falls through the casein discharge outlet of the upper chamber 11 and is introduced to the lower chamber 12 via its connected feed inlet. Here three stages of operations similar to those in the upper chamber 11 take place. Finally the casein falls through the casein discharge outlet 16 of this lower chamber which in effect provides a final drying chamber, and this fine casein riddlings and the dried casein are removed quickly by the bottom air-sealed conveyor 48, before overdrying and discoloration of these final particles takes place. The dried casein now has about 10 percent moisture content.

The heated air introduced into each chamber 11 or 12 passes upwards through the apertured screens 31 in that chamber with their layers of casein and finally out to atmosphere in a moisture-laden condition through the outlet duct in the upper part of the chamber.

As the machine is enclosed no casein is able to escape from the machine to the surrounding area and any fine dry particles tending to leave the machine into the air-stream are withheld by virtue of having to pass through the layers of wet casein above it. It will be appreciated that by having two drying chambers 11 and 12, one supplied with hot air and the second chamber supplied with air heated to a lower temperature a more even and efficient drying of the casein will take place. Insulation of the body of the machine will prevent heat loss in the vicinity of the machine as well as improving the drying efficiency.

I claim:

1. A casein or the like drying machine comprising a vertical cylinder divided into two separate chambers, an upper one of the chambers having an upper feed inlet and a lower feed outlet communicating with a lower one of the chambers providing an upper feed inlet to the lower chamber which also has a lower feed outlet, each chamber having a lower gaseous drying medium inlet, an upper gaseous drying medium outlet for each said chamber whereby flow of the drying medium is generally upward through each of said chambers, apertured gas-pervious screens fixed at different levels in the height of each chamber and extending across the chamber but for a gap through each screen, a vertical shaft extending through both chambers and journaled in the ends of each chamber, scraper members attached to the shaft and disposed adjacent the upper sides of the screens, drive means connected to

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the shaft to rotate the shaft to cause said scraper members to sweep above the screens, means positioning the gap in each screen out of register with the gap in the next upper screen in a direction rearward of the gap in the upper screen with respect to the direction of rotation of said scraper members, a chute mounted under the gap in each screen, and a perforated air pipe located in the chute, said pipe being connected to a high pressure air pump and directing air downward in the chute and comprising means for creating a back pres-

sure in the chute to prevent the drying medium from passing upward through the chute.

2. A casein or the like drying machine as claimed in claim 1 wherein each chute extends substantially the radius of the cylinder and between two arms of the particular spider.

3. A casein or the like drying machine as claimed in claim 1 wherein the screen comprises a plate of very fine stainless steel mesh.

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