June 7, 1966 J. G. BATES 3,254,428

APPARATUS FOR USE IN DRYING CASEIN OR LIKE PRODUCTS

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FIG. 1

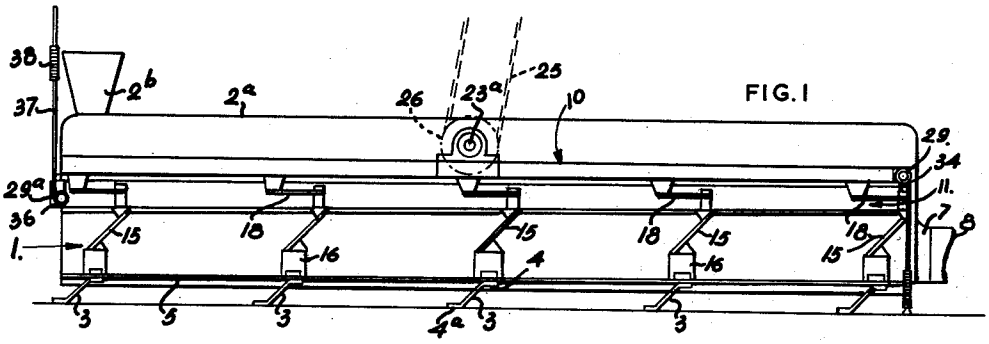



FIG. 2

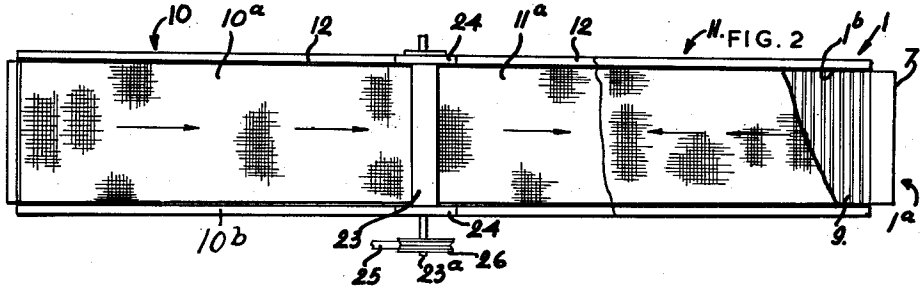
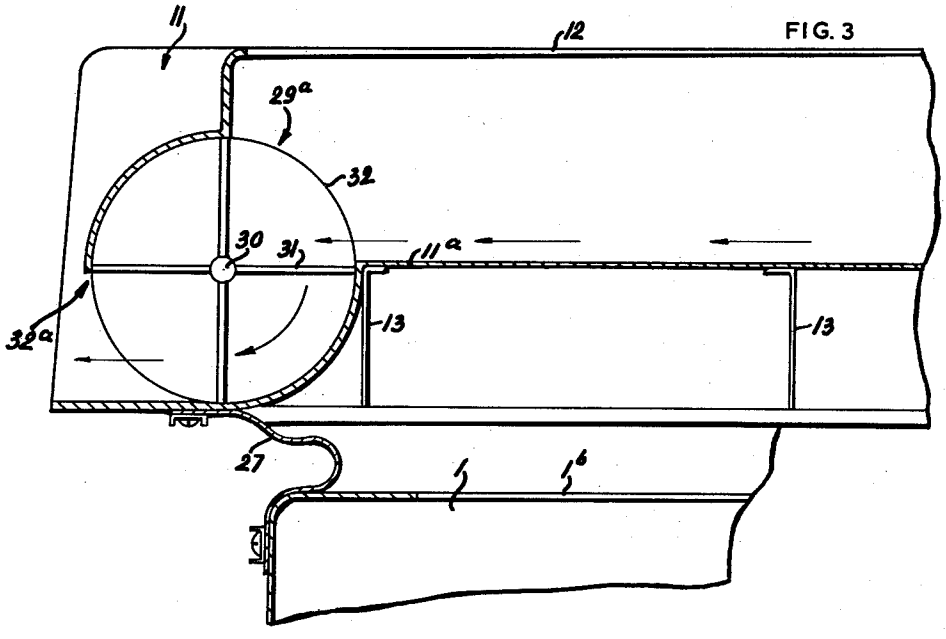



FIG. 3



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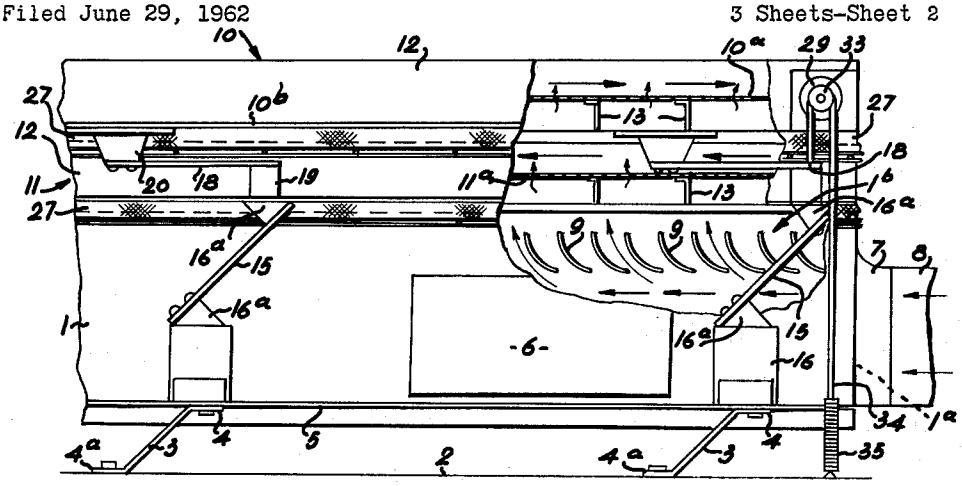



FIG. 4

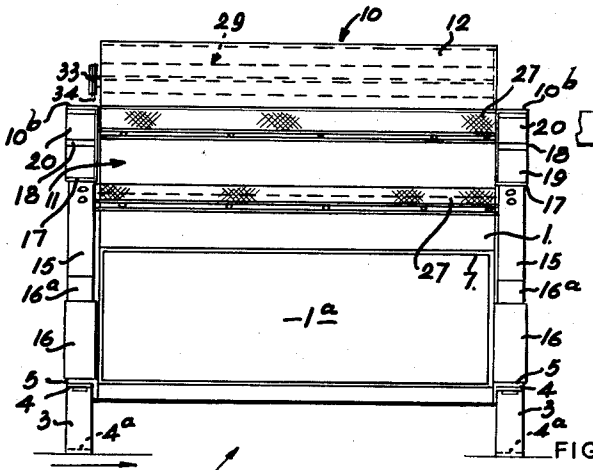



FIG. 5

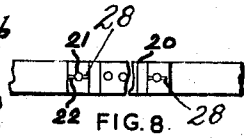



FIG. 8

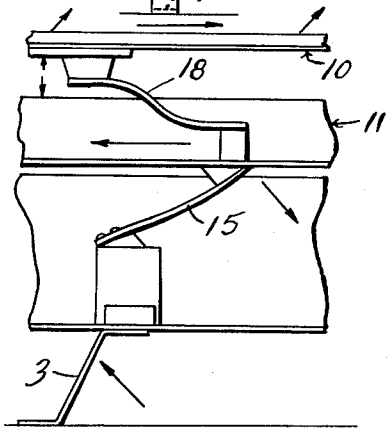



FIG. 6

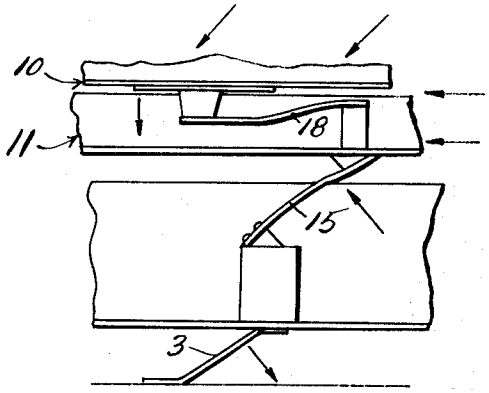



FIG. 7

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APPARATUS FOR USE IN DRYING CASEIN OR LIKE PRODUCTS

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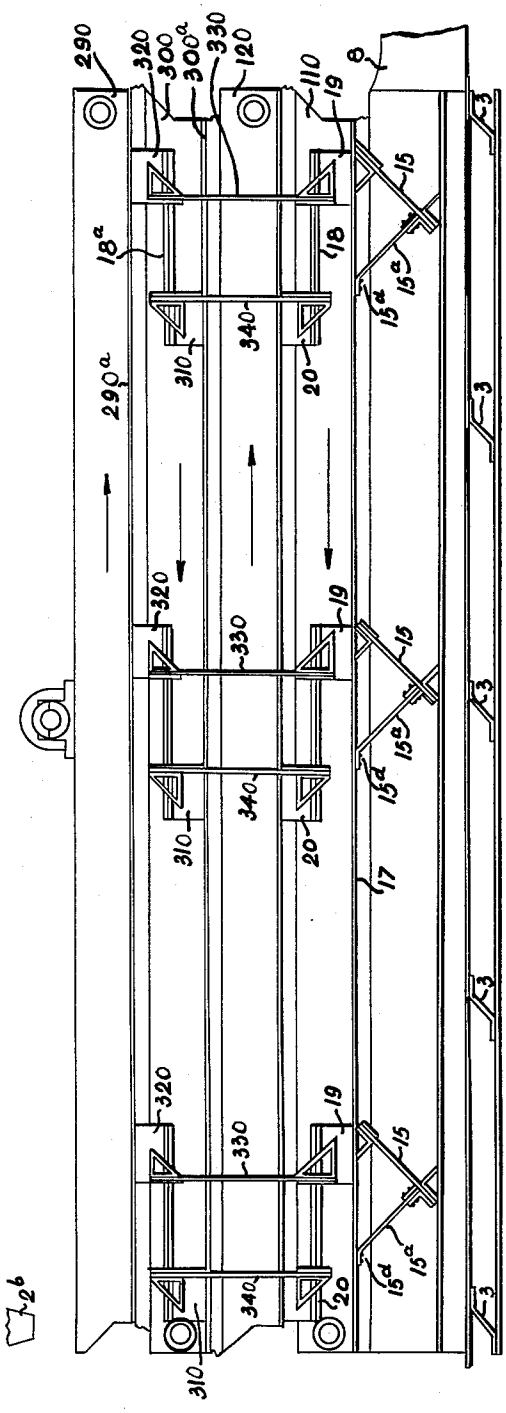



FIG. 9

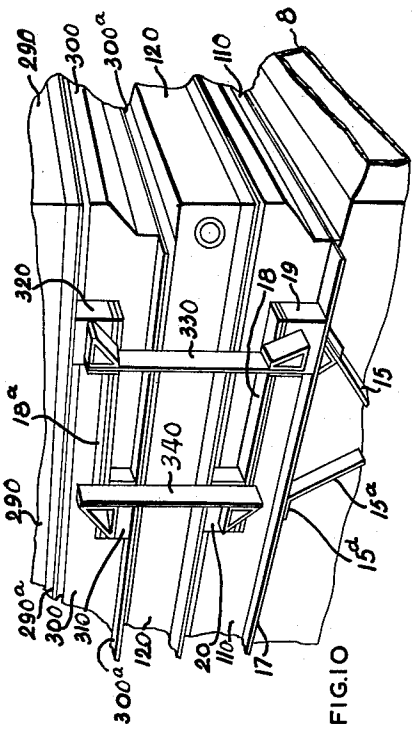



FIG. 10

United States Patent Office 3,254,428
Patented June 7, 1966



3,254,428

# APPARATUS FOR USE IN DRYING CASEIN OR LIKE PRODUCTS

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Filed June 29, 1962, Ser. No. 206,474
4 Claims. (Cl. 34—164)

The invention relates to apparatus for use in drying casein or like products, and in particular refers to apparatus of the conventional type wherein casein is moved across or spread over trays or screens for drying by heated air.

Movement of the casein in such apparatus has usually been carried out by a mechanical raking action, serving to spread or move the casein progressively along the tray or screen. However it has been found that such a mechanical raking action tends to break up the casein to some extent and create fine particles known as "fines," thereby reducing the quality of the casein. However in addition to this disadvantage, known casein drying apparatus do not provide for variation in the drying rate of the casein, with the result that "fines," which naturally dry quicker than casein in mass formation are burnt or at least over-dried. To avoid over-drying of the "fines," it is usual to limit the temperature of the heated air passing through the oven to say 160° Fahrenheit.

In my present invention, I provide an improved apparatus for use in drying casein or like products in which these disadvantages to which reference has been made, are eliminated, the improved apparatus being not only simple in construction and arrangement when compared with known types of casein-drying apparatus, but moreover is operated in a relatively simple and economical manner, eliminating the former known mechanical raking action so often detrimental to the quality of the casein. Furthermore my invention provides for the removal of "fines" from the apparatus during drying operations and as a result the working temperature can be maintained at a much higher degree.

According to one aspect of the invention the improved apparatus comprises an air duct supported on a plurality of springs, at least two horizontally disposed screen units mounted one above the other over the air duct, leaf type spring mountings connected between the air duct and the lowermost screen unit and between the screen units, and a vibratory means drivably connected to the screen units, the leaf type spring mountings between each mounting being so arranged relative to each other that when a vibratory action is applied to the screen units by the vibratory means material placed on the one screen will move in one direction along the screen unit and when dropped on to the next screen unit therebelow, will move in the opposite direction along the said screen unit, at the same time as air is passed via the air duct through the screen units to dry the casein.

The invention will now be described with the aid of the accompanying drawings in which:

FIG. 1 is a view in elevation of the improved apparatus,

FIG. 2 is a plan view (broken) of FIG. 1,

FIG. 3 is a part view in sectional elevation on a larger scale of one of the screens,

FIG. 4 is a part view (broken) of FIG. 1 but on a larger scale,

FIG. 5 is an end view in elevation of FIG. 4,

FIGS. 6 and 7 are schematical views of the spring mounting of the apparatus, illustrating movement of the spring mounting during operation of the apparatus,

FIG. 8 is a detail view in inverted plan of the attachment of springs of the apparatus,

FIG. 9 is a view in elevation of a further form of the invention; and



FIG. 10 is a part view in perspective of FIG. 9.

Referring now to the drawings, the base is formed by an air-duct **1** of rectangular and box-like proportions of sheet metal and frame construction. The air-duct **1** is greater in length than in depth and breadth and one end of the air duct is open as at **1a**, while the upper surface of the box-like air duct **1** is also open as at **1b**.

The box-like air duct **1** is mounted in a substantially horizontal position on a floor, bench, or the like **2**, by means of leaf-type springs **3** (referred to hereafter as the lower leaf springs **3**). More specifically the lower leaf springs **3** are of straight formation and the ends of each lower leaf spring **3** are bent in opposite directions to form lugs **4** and **4a** which are secured to the air duct **1** and to the floor **2** respectively. As illustrated with particular reference to FIGS. 1 and 4, the lugs **4** and **4a** are bent at corresponding angles to project from each side of the lower leaf springs **3** while further the angle of the lugs **4** and **4a** is such that with the lugs **4** and **4a** in position supporting the air duct **1** in a substantially horizontal position above the floor **2**, the lower leaf springs **3** all extend in a common direction and are inclined at an angle from the floor **2** at, for example, an angle of 45 degrees.

In a practical form of the invention, the air duct **1** is provided with longitudinal members **5** (see FIG. 4) of right angle formation when viewed endwise (see FIG. 5). The longitudinal members **5** are secured along each side wall of the air duct **1** adjacent the bottom edge of each side wall so that one leg of each longitudinal member **5** serves as a projecting flange to which the upper lugs **4** of the lower spring leaves **3** are secured (see FIGS. 4, 5 and 6).

The air duct **1** is further provided with one or more inspection doors **6** leading through a side wall of the air duct **1** while in addition the end opening **1a** (see FIG. 5) is provided with an extension **7** leading therefrom to which, a hose or funnel **8**, connected to a supply of heated air, is attached (see FIG. 4).

The air duct **1** also includes a series of air directing vanes **9** (see FIGS. 2 and 4) which serve to direct heated air evenly over the screens as will later be described. The vanes **9** are secured crosswise across the interior of the air duct **1** adjacent the upper opening **1b** of the air duct. As illustrated in FIG. 4 the vanes **9** are curved crosswise throughout their length and are secured between the inner surfaces of the side walls of the air duct **1** so that the concave surfaces of the vanes **9** are faced towards the open end **1a** of the air duct **1**.

In the apparatus described and illustrated, two screen units are provided positioned one over the other and situated directly over the upper opening **1b** of the air duct **1**. It will be understood however that any number of screen units can be used.

The two screen units which are indicated as an upper screen unit **10**, and a lower screen unit **11**, each consist of four outer walls of sheet metal forming frames **12** of rectangular proportions corresponding to the plan proportions of the air duct **1**. Each frame **12** includes a series of cross ribs **13** secured across its interior, and a section of suitable wire mesh screens **10a** and **11a**, or a perforated tray, fitting neatly within the interior of each frame **12** of the screen units **10** and **11**, is supported on the cross ribs **13**.

The wire mesh screens **10a** and **11a** form the actual screens along which the casein is moved for drying purposes, as will later be described.

The lower screen unit **11** is mounted directly over the upper opening **1b** of the air duct **1** and is supported and spaced from the air duct **1** by means of leaf-type springs **15** (referred to hereafter as the intermediate leaf springs **15**). More specifically mounting blocks **16** are secured on the upper surface of each longitudinal member **5** of the

air duct 1, a mounting block 16 being secured directly over each upper lug 4 of the lower leaf springs 3. The mounting blocks 16 serve as the point of attachment of the intermediate springs 15 to the air duct 1, while the upper ends of the intermediate leaf springs 15 are attached to a flange 17 projecting outwardly from the lower edge of each side wall of the lower frame unit 11. As illustrated in FIG. 4 the intermediate leaf springs 15 are positioned at an angle corresponding to the angle of the lower leaf springs 3, and to facilitate this angle mounting of the intermediate springs 15, triangular shaped spacing blocks $16^a$ space the intermediate leaf springs 3 from the flange 17 and from the mounting blocks 16, to hold the intermediate leaf springs 15 at the desired inclined angle.

The upper screen unit 10 is positioned and spaced from the lower screen unit 11 in a like manner with the exception that in this instance horizontal leaf springs (referred to hereafter as the upper leaf springs 18) support and space the upper screen unit 10 from the lower screen unit 11. More specifically spring supports 19 are mounted on the upper surface of the flange 17 of the lower screen unit 11, directly over the point of attachment of each intermediate leaf spring 15 to the under surface of the flange 17. Each upper leaf spring 18 is attached by one end to the upper surface of a support 19 with the upper leaf spring 18 extending horizontally therefrom so that the opposing end of each upper leaf spring is positioned in approximate vertical alignment with the point of attachment of the lower leaf spring 3 to the floor 2 directly therebeneath. The opposing ends of the springs 18 are then secured to brackets 20 projecting downwardly from the under-surface of a flange $10^b$ (see FIGS. 4 and 5) projecting at right angles from the lower edge of the side walls of the upper screen unit 10.

If desired, adjustment, or tolerance for expansion and contraction, can be allowed for between the brackets 20 and the flange $10^b$ by means of bolts 21 passing through slotted openings 28 in the brackets 20 (see FIG. 8) and into the flange $10^b$.

The vibratory means used in accordance with this invention may be of any suitable type capable of setting up a desired vibrating motion to agitate the screen units 10 and 11. For instance as illustrated in FIGS. 1 and 2, a vibratory unit including an unbalanced or eccentric shaft 23 can be provided mounted in bearings 24 across the upper screen unit 10. The eccentric shaft 23 is driven from a prime mover (not shown) by a belt drive 25 passed about a variable speed pulley 26 mounted on the end of the drive shaft $23^a$ of the eccentric shaft 23, the variable speed pulley 26 enabling the speed of rotation of the eccentric shaft 23 to be varied.

During operation of the improved apparatus, it is desirable to maintain the interior of the apparatus in as airtight a manner as possible. In this direction the resultant annular openings between the air duct 1 and the lower screen unit 10 and between the two screen units 10 and 11, are closed by surrounding strips of resilient material.

As illustrated in FIGS. 4 and 5, strips of canvas 27 are secured about the opening between the air duct 1 and the lower screen unit 11 and about the opening between the lower screen unit 11 and the upper screen unit 10, the strips of canvas 27 while closing off the annular opening referred to, also allow for independent movement of the screen units 10 and 11 and the air duct 1. Furthermore the upper surface of the upper screen unit 10 is closed by a cover $2^a$ (see FIG. 1) which is placed over the upper screen unit 10, or removably attached thereto, to maintain heated air within the apparatus.

The improved apparatus may also include rotary valves which pass casein from the upper screen unit 10 to the lower screen unit 11, and provide for controlled discharge of the casein from the lower screen unit 11 to outside the apparatus, the rotary valves serving to maintain heated air confined within the apparatus, yet at the same time allowing for the discharge of casein from the apparatus. More particularly the rotary valves which are generally indicated as upper rotary valve 29 and lower rotary valve $29^a$ (see FIG. 3) each consist of a shaft 30 from which radial vanes or paddles 31 extend (see FIG. 3). The lower rotary valve $29^a$ is positioned in the lower screen unit 11 at the end of the mesh screen $11^a$ as opposed to the opening $1^a$ of the air duct 1. More specifically the shaft 30 of the rotary valve $29^a$ is located level with the mesh screen $11^a$, the rotary valve 29 being enclosed by the wall of the frame 12 of the screen unit 11, with the exception of an inner opening 32 in line with the mesh screen $11^a$ and an opposed lower opening $32^a$ (see FIG. 3) leading through the end of the lower screen unit 11. Similarly a rotary valve 29 of the type described is positioned at the opposing end of the upper mesh screen $10^a$ of the upper screen unit 10 (see FIG. 4).

It will be appreciated that with the rotary valves 29 and $29^a$ being rotated by a suitable prime mover, the paddles or vanes 31 maintain the opening 32 of each valve 29 and $29^a$ closed, so that in the case of the lower valve $29^a$, only a relatively small amount of heated air escapes, as casein passes from the end of the mesh screen $11^a$ through the opening 32 for discharge from the apparatus.

When a vibrating action is applied to the apparatus by the vibratory means an agitating action is applied to the screen units 10 and 11 through the medium of the spring leaf mountings in a manner to effect movement of the casein along the mesh screens $10^a$ and $11^a$ of both the screen units 10 and 11 in opposed directions (see horizontal arrows, FIGS. 2 and 4). To particularize further on this aspect of the invention, it will be appreciated that when the vibratory action is applied to the apparatus, the springs of the air duct 1 and two screen units 10 and 11, act in conjunction with one another to effect movement of the casein along the mesh screens $10^a$ and $11^a$ of the two screen units 10 and 11 in opposed directions. The movement of the leaf springs of the air duct 1 and the two screen units 10 and 11, is illustrated in the schematical views (FIGS. 6 and 7) which, for the purpose of illustration, have been exaggerated. It will be observed from the arrows illustrating the direction of movement of the units that the positioning of the leaf spring mountings relative to one another, move the two screen units 10 and 11 not only in an up and down movement and away from one another, but in addition an endwise movement is also applied. In FIGS. 6 and 7 two stages of the agitation of the screen units 10 and 11 are illustrated, FIG. 6 illustrating movement of the two screen units 10 and 11 away from one another, and FIG. 7 closing movement of the two screen units toward one another.

In operation and with the screen units 10 and 11 and rotary valves in operation casein is passed through a filler funnel $2^b$ in the cover $2^a$ onto the end of the mesh $10^a$ of the upper screen unit 10 as opposed to the rotary valve 29. The mass or agglomeration of casein is then moved along the mesh screen $10^a$ of the upper screen unit 10 by the agitating movement of screen unit 10 as already described, and passed through the rotating upper rotary valve 29 onto the end of the lower mesh screen $11^a$ of the lower screen unit 11 immediately therebelow, whereon the casein is moved in the opposite direction along the mesh screen 11 by agitating movement of the lower screen unit 11, for ultimate discharge from the apparatus through lower rotary valve $29^a$. During progress of the casein along the two mesh screens $10^a$ and $11^a$, heated air is delivered via the funnel 8 (see arrows FIG. 4) opening into the air duct 1 where the heated air is directed in an upwardly direction by the vanes 9 onto the mesh screen $10^a$ and $11^a$, to dry the casein.

In this latter direction the agglomeration or mass of casein on the mesh screens $10^a$ and $11^a$ check the rate of penetration of the heated air through the mesh screen $10^a$ and $11^a$ (see curled arrows FIG. 4) with the result that the heated air is to some extent retained beneath the mesh screens $10^a$ and $11^a$. However due to the fact that

the casein, upon reaching the lower mesh screen 11a is already partially dried, the rate of penetration of the heated air through the lower mesh screen 11a and casein thereon, is more rapid, than through the comparatively wet casein on the upper mesh screen 10a.

Although rotation of the two rotary valves 29 and 29a can be effected in any manner, it is preferred that the rotary valves 29 and 29a be rotated in the simple and economical manner as illustrated in the FIGS. 1 and 4 of the drawings.

As shown a V-pulley 33 is secured on the shaft of the rotary valve 29, and a length of V-belting 34 is anchored to the upper screen unit 10 or an upper leaf spring 18, and then led upwardly about the pulley 33. The opposing end of the belting 34 is attached to a length of coiled spring 35 which in turn is anchored to the floor 2. In a similar manner the remaining lower rotary valve 29a is provided with a V-pulley 36 and a length of V-belting 37 anchored to the under side of the upper screen unit 10, is passed about the pulley 36 and attached to a coil spring 38 which in turn is anchored to a stationary object above the upper screen unit 10. The arrangement is such that upon the screen units 10 and 11 being agitated, the spring-loaded lengths of belting 34 and 37 are moved in a ratchet-like manner on the pulleys 33 and 36, i.e. lengths of belting 34 and 37 are tensioned or tightened against spring tension to turn the pulleys 33 and 36 when the screen units 10 and 11 are moved away from one another. When the screen units 10 and 11 move together, the lengths of belting 34 and 37 are slackened and do not return the pulleys 33 and 36.

In a further form of the invention and as illustrated in FIGS. 9 and 10 the construction and connection of the springs is varied and strengthened to carry more than two screen units, for example four screen units.

More specifically and as illustrated in FIG. 9 the air duct 1 is mounted on lower leaf springs 3 as has already been described, while the intermediate inclined leaf springs 15 are strengthened by the addition of leaf spring stays 15a secured by one end to the lower end of each intermediate leaf spring 15 and extending from the intermediate leaf springs 15 substantially at right angles to the latter. The opposing and upper end portion of each leaf spring stay 15a is bent in the form of a lug 15d which is secured to the underside of the flange 17 of the lower screen unit 110.

The mounting of the screen units illustrated in FIGS. 9 and 10 is substantially the same as that illustrated in FIG. 4, except in this instance the topmost leaf springs 18a supporting the mounting of the topmost screen unit 290 on the screen unit 300 immediately therebelow, extends in the opposite direction to the leaf springs 18 immediately therebeneath and supporting the second screen unit 120.

More specifically each leaf spring 18a is secured between a support 310 secured on the upper flange 300a of the next or third screen unit 300 while the opposing end of the leaf spring 18a is attached to a further support 320 secured on the underside of the surrounding flange 290a of the top-most or fourth screen unit 290.

In each group of springs described and illustrated additional vertically positioned leaf springs are provided secured between the supports of the vertically aligned leaf springs 18 and 18a to provide the support of the two upper screen units 290 and 300 on the two lower screen units 110 and 120. More specifically a vertically positioned leaf-type spring 330 is secured between the support 19 of the lowermost screen unit 110 and the support 320 of the topmost screen unit to connect the topmost and lower screen units 290 and 110.

A second vertically positioned leaf-type spring 340 is joined between the support 20 of the second screen unit 110 and support 310 of the third screen unit 300 to connect the two intermediate screens 300 and 120.

It will thus be observed from the aforegoing description that when a vibrating motion is applied to the topmost screen unit by the vibratory unit, vibrations are transmitted via the vertical leaf springs 330 and 340 to the two lower spring units. More specifically it will be understood that when spring 18a is moved up and down, the ends or supports 310 and 320 oscillate to apply a similar oscillating movement to the vertical spring leaves 330 and 340. By means of such an arrangement the vibrating motion is applied to the two lower screen units so that the vibrations applied to the two lower screen units will cause the two lower screen units 110 and 120 to move casein placed therein in opposite directions.

What I do claim and desire to obtain by Letters Patent of the United States of America is:

1. Improved apparatus for use in drying casein or the like comprising an air duct, a plurality of springs supporting said air duct, at least two horizontally disposed screen units mounted one above the other and over and in communication with said air duct to facilitate the passage of air from the air duct and through the screen units, leaf-type springs connected between said air duct and the lowermost screen unit and between the screen units, a vibratory means drivably connected to the screen units and in which said leaf-type springs connected between the air duct and the lowermost screen units are intermediate leaf springs inclined outwardly in a common direction and the leaf-type springs supporting the next screen unit on the lowermost screen unit are horizontally disposed leaf springs each secured to the lowermost screen unit above the inclined intermediate springs and extending in a direction substantially opposed to the outward incline of the intermediate springs and joined to the next screen unit thereabove so that when a vibratory action is applied to the apparatus, the screen units will be vibrated in such a manner that material placed thereon will move in opposite directions at the same time as air is passed via the air ducts through the screen units to dry the casein.

2. Apparatus for use in drying casein or the like as claimed in claim 1 including four screen units mounted one above the other, the topmost or fourth screen unit being mounted on upper horizontally disposed leaf springs connected to the third screen unit therebelow, the said upper leaf springs extending in the opposite direction to the lower leaf springs joined between the two lower screen units, and a vertically disposed leaf spring extending between the connection of the lower leaf spring on the lowermost screen unit and the connection of the upper leaf spring on the topmost screen unit, and a second vertically disposed leaf spring joined between the connection of the lower leaf spring to the second screen unit, and the connection of the upper leaf spring to the third screen unit.

3. Apparatus for use in drying casein or the like as claimed in claim 1 and wherein the inclined leaf-type springs extending between the air duct and the lowermost screen unit are supported by leaf spring stays extending approximately at right angles between the intermediate leaf springs and the lowermost screen unit.

4. Improved apparatus for use in drying casein or the like comprising air duct supported on a plurality of springs, at least two horizontally disposed screen units mounted one above the other and over and in communication with the air duct, to facilitate the passage of air from the air duct and through the screen units, leaf-type spring mountings connected between the air duct and the lowermost screen unit and between the screen units, a vibratory means drivably connected to the screen units, the leaf-type spring mountings between each unit being so arranged relative to each other that when a vibratory action is applied to the screen units by the vibratory means, material placed on the one screen unit will move in one direction along such screen unit and when dropped on to the next screen unit therebelow, will move in the opposite direction along said next screen unit, at the same time as air is passed via the air duct through the screen units to dry the casein, a rotary valve means for each

screen unit for controlling the discharge of casein from each screen unit, each rotary valve means including a shaft, a pulley on each shaft and means for rotating each rotary valve means including a tautened and spring-influenced length of belting trained over each of said pulleys with one end of each length of belting being anchored to the apparatus and the other end of each length of belting being anchored independently of the apparatus.


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