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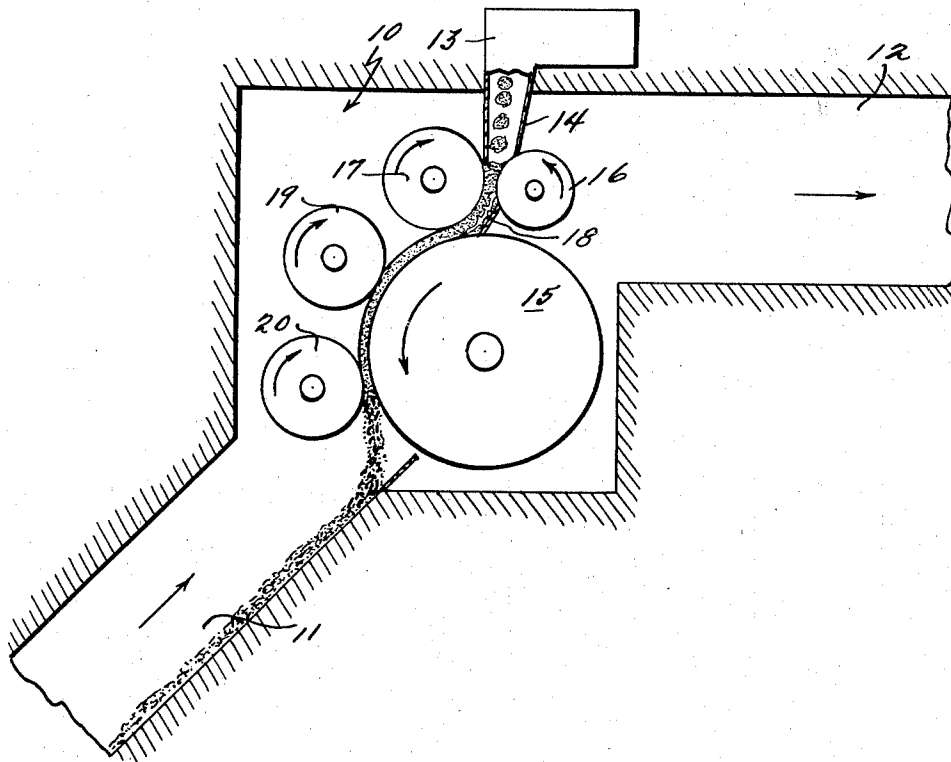
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PROCESS AND APPARATUS FOR DRYING CAKING PRODUCTS

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3 Sheets-Sheet 1

F I G. I.



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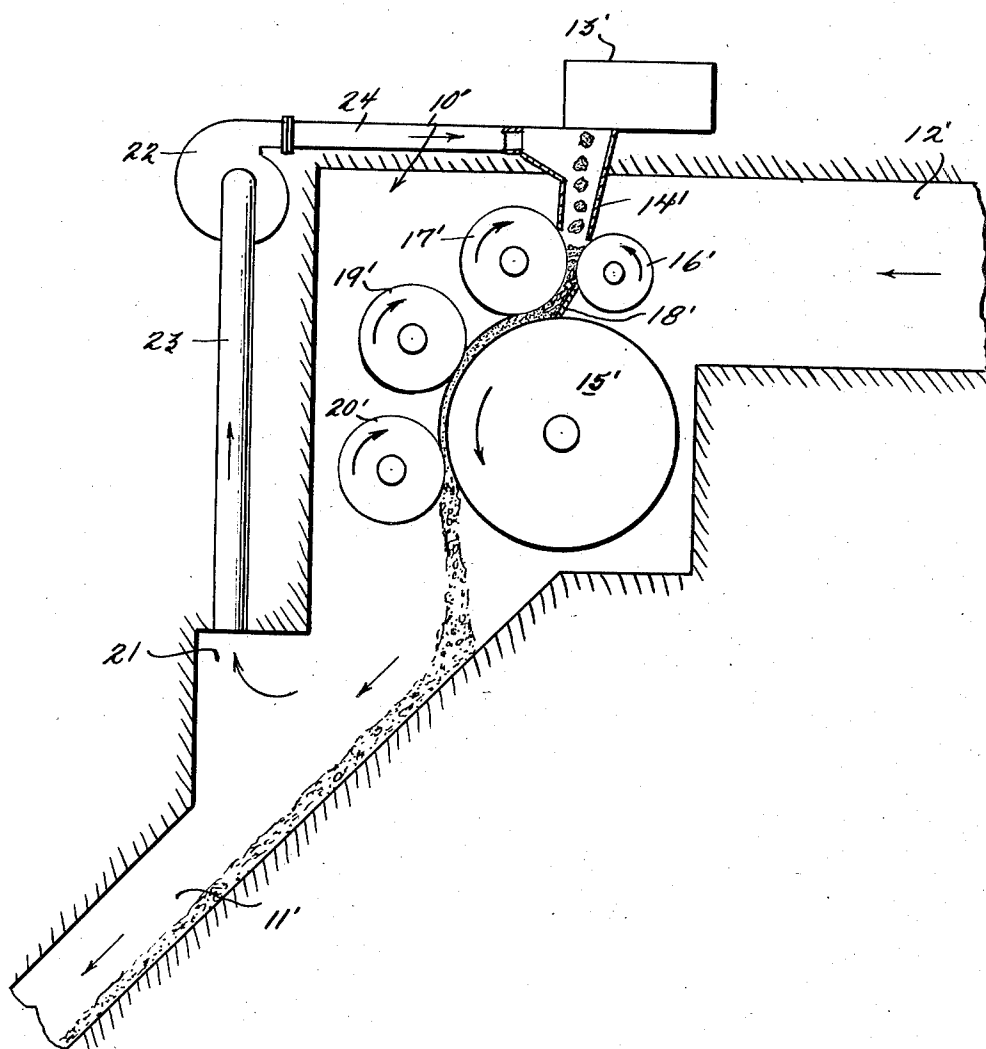
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F I G. 2.



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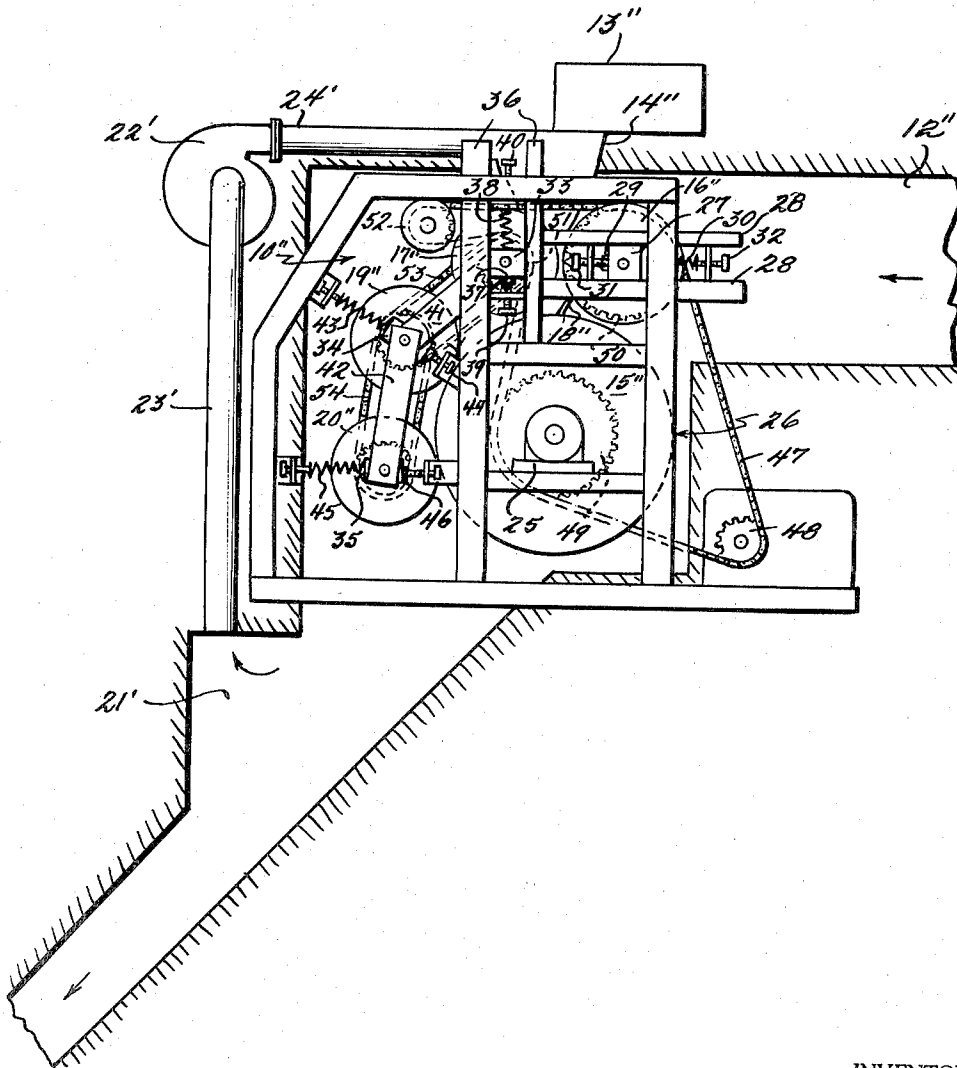
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PROCESS AND APPARATUS FOR DRYING CAKING PRODUCTS

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FIG. 3.



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PROCESS AND APPARATUS FOR DRYING
CAKING PRODUCTS

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This invention relates to processes and apparatus for drying products and has more particular reference to processes and apparatus for drying caking products such as mud or products of colloidal or semi-colloidal structure.

Drying of caking products such as mud or products of colloidal or semi-colloidal structure presents difficulties caused by the fact that rational and homogeneous drying of a product calls for a very fine division of the particles in order to obtain an intimate contact between the particles and the drying medium. This division is difficult to obtain with muddy and caking products. In fact, these products tend to form lumps which only dry superficially and whose core remains inaccessible to heat exchange, owing to the defective heat transmission frequent in these products, especially when they are clayey.

Known are driers which employ two cylinders for crushing the lumps of such products; however, these driers feed directly a pair of drying cylinders and the products, which only remain in contact with these cylinders for a very short period, finish drying in falling upon other heat exchange elements, causing the destruction of the layer obtained by the passage between the two cylinders, so that products insufficiently dried when leaving the cylinders are likely to re-agglomerate.

The object of the present invention is to provide a novel process of and improved apparatus for overcoming the above defects by presenting the products to be dried in the form of a very thin endless layer, placed upon a moving surface on which they remain, and which carries them forward during the drying process, in order to leave them intact and to bring them into contact with a series of laminating cylinders.

Another object of the present invention is to provide improved apparatus, as characterized above, wherein the moving surface which receives the thin endless layer of the products to be dried comprises a large cylinder mounted in a chamber and wherein the products to be treated are fed between a spaced pair of feed cylinders to form the thin endless layer which is placed upon the large cylinder.

A further object of the present invention is to provide improved apparatus, as characterized above, wherein said large cylinder is mounted for rotation about a fixed axis and said other cylinders are mounted for rotation about an axis movable toward and from the large cylinder so that these cylinders may move outward to permit the passage of any foreign objects in the products being treated.

Other objects and advantages of the invention will appear in the following specification when considered with the accompanying drawings, wherein:

Fig. 1 is a diagrammatic side elevational view showing one embodiment of a drier construction in accordance with the present invention;

Fig. 2 is a view similar to that shown in Fig. 1, but showing a modified form of apparatus; and

Fig. 3 is a view similar to that shown in Fig. 1, but

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showing still another modified form of the apparatus.

The present invention provides a novel process and improved apparatus for drying caking products such as mud or the like and, in general, comprises a drying chamber in which is mounted a movable surface in the form of a large cylinder; a pair of feed cylinders positioned to receive between them the lump products to be treated and crush and press them into a very thin endless layer which moves onto the large cylinder and rotates therewith while being pressed by a plurality of laminating cylinders. A flow of heated drying gas continuously flows through the chamber for heating the cylinders and the product. The flow of the drying gas through the chamber may be either "methodic" or "antimethodic."

After the thin layer of products has passed between the last of the laminating cylinders and the large cylinder, it will be completely dried and break up and fall into the outlet chute from the chamber.

The invention further contemplates mounting the cylinders between which the layer of products passes, movable relative to one another so that foreign bodies in the products may readily pass through the apparatus.

Referring now to the drawings, there is diagrammatically illustrated in Fig. 1, one embodiment of a drier constructed in accordance with the present invention. As there shown, the drier comprises an elongated substantially rectangular chamber 10 having an inlet opening 11 for the hot drying gases and an outlet opening 12 for the exhausting of the drying gases; a feed plate 13 through which the products to be dried are fed into a feed chute 14 opening into the chamber; a large hollow central cylinder 15 rotatably mounted therein; a pair of feed cylinders 16 and 17 rotatably mounted therein; a scraper 18; and a plurality of laminating cylinders 19 and 20 rotatably mounted therein. The cylinders 16, 17, 19 and 20, preferably and as shown, are hollow.

The operation of the apparatus is as follows:

The products to be treated are fed through the feed plate 13 with a constant or intermittent output and are discharged through the chute 14 between the feed cylinders 16 and 17, which rotate in opposite directions, as indicated by the arrows, and which crush the lumps and elongate them into a layer adhering to the cylinder 17. The products remaining caked upon the cylinder 16 are scraped off by the scraping blade 18 and fall upon the cylinder 15, which, as it rotates, brings them into contact with cylinder 17, so that all the products falling between the feed cylinders 16 and 17 are formed into a thin solid layer calipered by the distance between the two feed cylinders. The thin endless layer of products formed by the passage of the products between the two feed cylinders passes downwardly onto the large central cylinder 15 and is carried along by this cylinder as it rotates and is successively brought into contact with the laminating cylinders 19 and 20 rotating inversely to the large cylinder at a predetermined speed, which may be the same as or different from the peripheric speed of the large cylinder. These laminating cylinders compress the layer more and more, as a series of rolling mills, while leaving the upper surface of the layer between the cylinders 17, 19 and 20 in free contact with the hot gases. The hollow cylinders have both their external and internal surfaces heated by the hot gases and transmit this heat direct to the products being dried. After passing between the large cylinder and the lowermost of the laminating cylinders, the dried layer breaks up and falls through the chamber and passes out through the opening 11. As the products fall through the chamber they will be further dried by direct contact with the hot gases.

This method, while giving excellent exchange condi-

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tions between the heating gases and the products to be dried, is dangerous when these products are of an inflammable nature.

The modified form of drying apparatus diagrammatically illustrated in Fig. 2, provides for an anti-methodic circulation of the drying gas. In this modification, the chamber 10', the feed plate 13', chute 14', scraper 18', and cylinders 15', 16', 17', 19' and 20' are generally similar to the corresponding members as shown in Fig. 1. However, in this particular modification, the hot drying gases enter the chamber 10' through opening 12', pass over the several cylinders, and are drawn into an expanding chamber 21 located on the discharge side of the dried products, by means of a blower 22 which draws the gases, containing small products, from the expansion chamber 21 through a conduit 23 and discharges them through pipe 24 into the feed chute 14' of the feeder 13'. The gases are then discharged on one or both sides of the chute 14. Thus is obtained the precipitation of the small particles in suspension in the drying gases by this rough projection on a surface wetted by the moist products entering the drier or on the moist products themselves. The dried products are evacuated through opening 11'.

In Fig. 3 there is diagrammatically illustrated another modification of drying apparatus constructed in accordance with the present invention. In this particular modification, the chamber 10'' with its expansion chamber 21', feeder 13'' with its chute 14'', scraper 18'', blower 22' with its suction and discharge pipe lines 23' and 24', respectively, are generally similar to the corresponding parts shown in Fig. 2. Also, the cylinders 15'', 16'', 17'', 19'' and 20'', except for the manner in which they are mounted, are generally similar to the corresponding members shown in Fig. 2.

As shown in Fig. 3, the cylinder 15'' rotates between fixed bearings 25 suitably mounted on a structural frame indicated generally at 26, formed in the chamber 10''. Cylinder 16'' rotates between movable bearings 27 slidably mounted between two vertically spaced, horizontally extending parallel slides 28, suitably mounted in the structural frame 26. Each of the bearings 27 is pressed against adjustable thrust members 29 by suitable compression springs 30. Screws 31 and 32 adjust the thrust members and springs respectively.

Cylinders 17'', 19'' and 20'' rotate in bearings 33, 34 and 35, respectively. The bearings 33 are slidably mounted in vertical parallel slide guides 36 secured on the frame structure 26 and are resiliently pressed against adjustable thrusts 37 by adjustable springs 38. Thrusts 37 are adjustable, as by means of screws 39, and springs 38 are regulated as by screws 40. Bearings 34 are mounted at the end of a pair of levers 41 which are hinged upon the bearings 33; bearings 35 are mounted at the end of a pair of levers 42 which are hinged on bearings 34. Bearings 34 are pushed by adjustable springs 43 onto adjustable thrusts 44. Bearings 35 are pushed by adjustable springs 45 onto adjustable thrusts 46. The foregoing construction provides a movable suspension of the compressing cylinders while an adjustable and accurate position of these cylinders is assured in relation to cylinder 15'', with the help of the thrusts 37, 44 and 46. The springs 38, 43 and 45 permit the cylinders to move away from the cylinder 15'' to permit foreign objects in the products to pass therebetween.

The drive of the cylinder assembly is provided as by a chain 47 driven by a pinion 48 and driving pinions 49, 50 and 51 keyed to the shafts of cylinders 15'', 16'' and 17'', respectively. The pinion 48 is driven by any suitable means, not shown, and the chain 47 is properly tensioned as by a tensioning pinion 52. Cylinder 19'' is driven by cylinder 17'' as by means of a driving chain belt 53 passing over pinions keyed on the shafts of cylinders 17'' and 19'', respectively. Cylinder 20'' is driven by cylinder 19'' as by means of a drive chain belt

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54 passing over pinions keyed on the shafts of cylinders 19'' and 20'', respectively.

The operation of this modification of drying apparatus is identical to that shown in Fig. 2, except that all of the small cylinders are mounted for movement to permit passage of foreign products through the drier. The products being dried are fed from the feeder 13'' through chute 14'' between the cylinders 16'' and 17'', where they are pressed into a cake which passes down between the large cylinder 15'' and the small cylinders 19'' and 20''. During the travel of the products being dried they are subject to contact with a hot drying gas admitted into the chamber through opening 12''. The drying gases heat the cylinders and dry the products, then pass through the expansion chamber 21' from which they are evacuated through conduit 23' by blower 22' and forced through conduit 24' onto feed chute 14'' of the feeder 13'.

From the foregoing, it readily will be seen that there has been provided a novel process and improved apparatus for drying caking products; apparatus which comprises a drying chamber in which is mounted a pair of feed cylinders for receiving the products to be dried and form them into a thin layer which passes onto a large central cylinder and rotates therewith while being compressed by a plurality of laminating cylinders, and means for passing a flow of heating gas through said chamber to dry said products; one in which all of the cylinders except the large cylinder, are mounted on movable axes to permit the passage through the drier of any foreign objects in the products being dried.

While the hollow cylinders are heated both exteriorly and interiorly by the hot gases passing through the chamber, obviously, they could be heated separately by other suitable means. Obviously, the exterior surface of the cylinders may be either smooth or corrugated.

Obviously, too, the invention is not restricted to the particular embodiments thereof herein shown and described.

What is claimed is:

1. A process of drying caking products such as mud or the like which comprises continuously feeding the products to be dried between a spaced pair of continuously rotating cylindrical surfaces rotating in opposite directions in a chamber for pressing the products into a thin layer; continuously depositing the thin layer as formed onto a continuously rotating cylindrical surface rotating about a horizontal axis in said chamber and continuously subjecting said layer of products as it rotates with said last named surface to the laminating pressure of a plurality of continuously rotating cylindrical surfaces whereby said layer will be made thinner as it moves downwardly through said chamber; and continuously directing a flow of a hot gaseous medium downwardly through said chamber for thoroughly drying said layer of products as it moves downwardly through said chamber and so that the temperature of the drying gas when it contacts the dried products will be reduced, thereby reducing the chance of spontaneous combustion when the dried products are inflammable.

2. A process for drying caking products such as mud or the like, as set forth in claim 1, including the step of continuously withdrawing the hot gaseous medium from the bottom of the chamber and directing its flow against a surface wetted by the streams of wet products as they are fed into the chamber, whereby any smaller particles in suspension in the gaseous medium will be precipitated and recovered with the dried products.

3. Apparatus for drying caking products such as mud or the like comprising a chamber; means including a chute for feeding the products to be dried into said chamber; a spaced-apart pair of feed cylinders rotatably mounted in said chamber for rotation in opposite directions about horizontal axes, said pair of feed cylinders being positioned to receive between them the products

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discharged into the chamber by said chute and press them into a thin layer as they pass downwardly between the cylinders; a large cylinder mounted for rotation about a horizontal axis and positioned in said chamber below said feed cylinders to receive said layer of products thereon as it is formed for rotation therewith; a plurality of vertically spaced laminating cylinders mounted in said chamber for rotation about horizontal axes, said laminating cylinders being positioned to engage and press the layer of products passing between them and said large cylinder to make said layer thinner; and means including conduits for directing a flow of a hot gaseous medium downwardly through said chamber for drying said products as they move downwardly therethrough and so that the finally dried products will contact the drying gas after it has lost some of its heat, thereby reducing the chance of spontaneous combustion when said dried products are inflammable.

4. Apparatus as set forth in claim 3, wherein means including conduits and a blower are provided to suck the heated gaseous medium from the bottom of said chamber and blow it onto the wet products falling through said inlet chute.

5. Apparatus as set forth in claim 3, wherein said large cylinder is mounted for rotation about a fixed axis and wherein all of the cylinders which engage the layer of products on said large cylinder are mounted for rotation about axes movable toward and away from the periphery of the large cylinder, resilient means normally urging said movable cylinders toward said large cylinder, and adjustable thrust means for limiting the pushing movement of said movable cylinders toward said large cylinder.

6. Apparatus for drying caking products such as mud or the like comprising a drying chamber; means including conduits for admitting a flow of a heated gaseous medium through said chamber; means including a chute for feeding the products to be dried into said chamber; a large cylinder mounted in said chamber below said chute with its shaft journaled in fixed bearings for rotation about a horizontal axis; a spaced pair of feed cylinders mounted in said chamber between said chute and the top of said large cylinder, each of said feed cylinders having its shaft journaled in bearings slidably mounted in slide guide-

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ways; means including an adjustable thrust member and an adjustable spring member for normally holding one of said feed cylinders at a predetermined distance from the other of said feed cylinders; means including an adjustable thrust member and an adjustable spring member for normally holding said other of said feed cylinders at a predetermined distance from the large cylinder; and a plurality of vertically spaced laminating cylinders mounted in said chamber for rotation about horizontal axes and positioned to engage and compress the layer of products on said large cylinder, the construction and arrangement being such that as the products being treated pass between said feed cylinders they will be pressed into a thin layer and passed onto the large cylinder and be further compressed and thinned by the laminating cylinders.

7. Apparatus as set forth in claim 6, wherein the upper of shaft laminating cylinders has its shaft journaled in bearings carried by a pair of levers pivotally suspended from the bearings of the other of said feed cylinders and the remainder of the laminating cylinders have their shafts journaled in bearings carried by a pair of levers pivotally suspended from the bearings of the preceding laminating cylinder.

8. Apparatus as set forth in claim 7, wherein each of said laminating cylinders is movable toward and from said large cylinder to permit the passage of foreign objects in the products being treated between the large cylinder and the laminating cylinders, and means, including an adjustable thrust member and an adjustable spring member, are provided for normally holding said laminating cylinders a predetermined distance from said large cylinder.

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