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Bachmann

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[54] **APPARATUS FOR DRYING FLUENT MATERIALS**

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[51] **Int. Cl.**... **F26b 19/00**

[58] **Field of Search**.............................. 34/179–183, 34/130, 168, 108, 109, 136–137, 124–125, 14, 17; 110/14; 432/105, 108, 110, 118, 112, 111, 48, 49, 51

[56] **References Cited**

UNITED STATES PATENTS

3,222,797	12/1965	Zies	34/14
3,603,001	9/1971	Arnold	34/136
2,510,057	6/1950	Baker et al.	34/183
3,323,222	6/1967	Skidmore et al.	34/17
3,230,865	1/1966	Hibbel et al.	34/14
3,720,004	3/1973	Okawara	34/130
2,452,249	10/1948	Leiske	34/183
3,717,937	2/1973	Thompson	34/136

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[57] **ABSTRACT**

An apparatus for drying fluent materials with an approximately horizontally arranged cylindrical conduit as well as a rotor rotating internally of such conduit. The rotor supports vane-like elements operatively associated with the inner wall of the conduit. The rotor carries a number of such elements which are successively arranged in the direction of rotation thereof and serve for wiping, circulating, comminuting and scraping of the fluent material. One of the elements is constructed at least as a wiper element and a further element is constructed at least as a scraper element, the free edge of which travels closer to the inner wall of the conduit that the free edge of the wiper element. The scraper element has throughpassage openings for scraped-off material.

21 Claims, 9 Drawing Figures

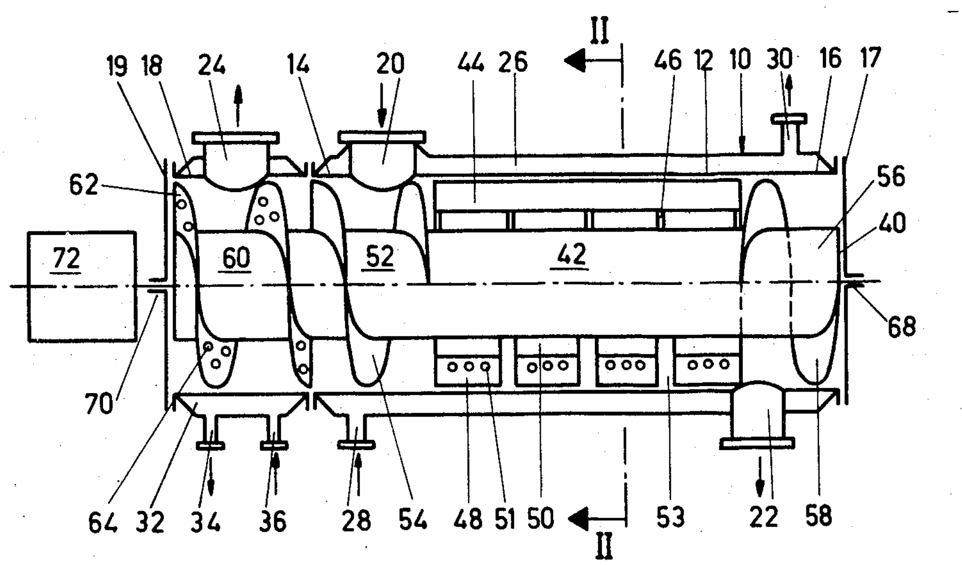
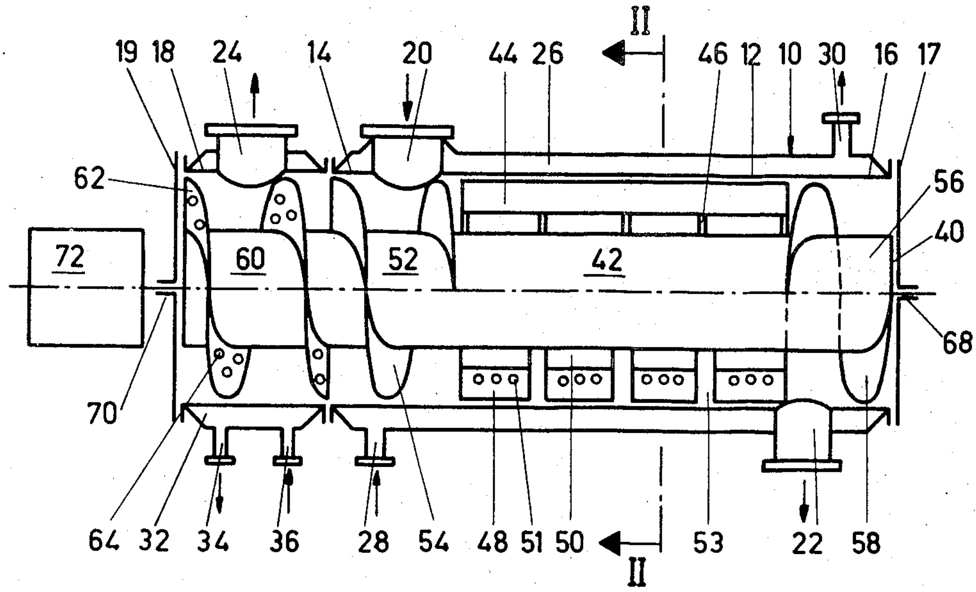


Fig. 1



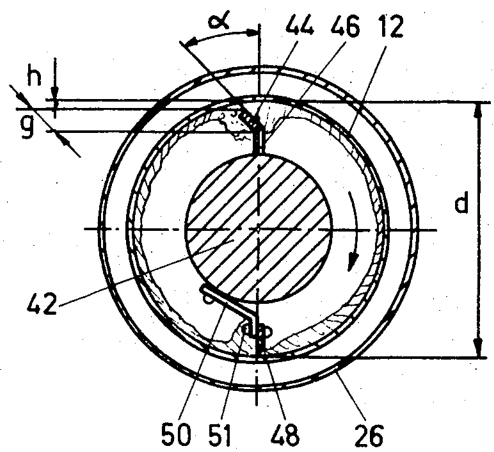


Fig. 2

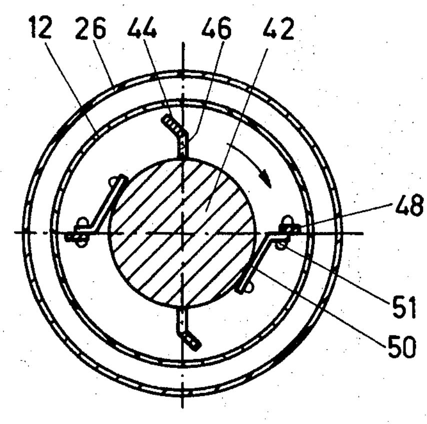
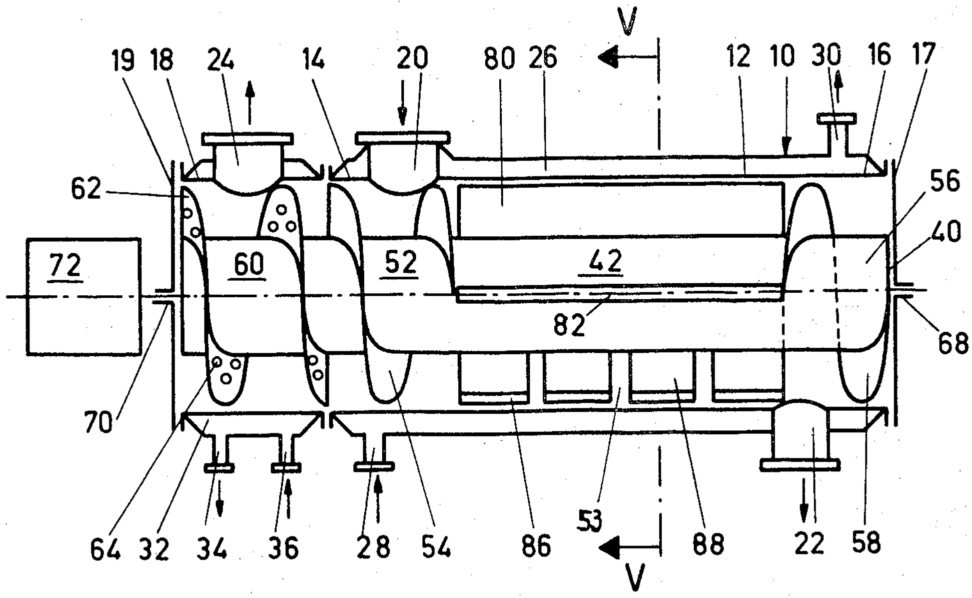


Fig. 3

Fig. 4



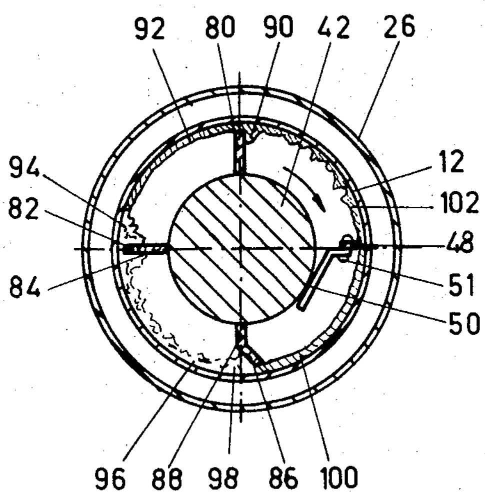


Fig. 5

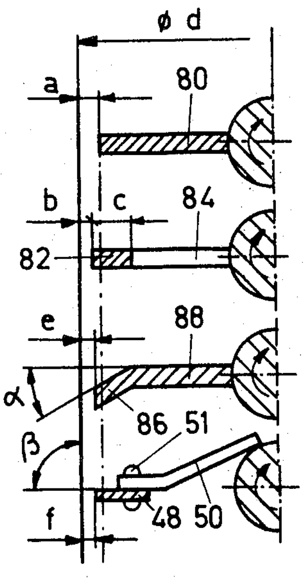


Fig. 6

Fig. 7

Fig. 8

Fig. 9

APPARATUS FOR DRYING FLUENT MATERIALS

BACKGROUND OF THE INVENTION

The present invention relates to a new and improved apparatus for drying fluent materials.

A dryer construction is already known to the art which embodies an approximately horizontally arranged heatable treatment compartment or chamber. A rotor is coaxially arranged within this treatment compartment. Star-shaped arms are secured to the rotor, at the ends of which there are provided blades or bucket elements. The blade elements extend up to the direct neighborhood of the wall of the treatment compartment. The arms supporting the blade elements are arranged at the rotor along a helical line, it being important that one blade partially overlaps the preceding blade viewed in the peripheral direction of the rotor. During operation of this dryer the material to be processed arrives in the treatment compartment through the agency of an inlet connection or stud. Within this compartment the material is engaged by the blade elements and conveyed in the form of a spiral-shaped band as a thin layer towards an outlet connection or stud. Along its path from the inlet connection to the outlet connection the material is subjected to thermal treatment, the liquid part of the material being vaporized, that is to say, the material is dried.

A drawback of this dryer resides in the fact that owing to the selected blade arrangement the material to be treated is conveyed in a band-like configuration over the treatment wall, and therefore, there is not possible optimum utilization of the available treatment surface.

Furthermore, during operation of this state-of-the-art dryer, especially during treatment of pasty-like materials, there are formed agglomerations or lumps from which moisture is difficult to expel or cannot be expelled to the desired degree. Owing to this insufficient treatment of the material a final product departs from the dryer having an irregular or non-uniform moisture content. This drawback can be partially overcome in that the delivery of heat to the treatment compartment is controlled by a control mechanism. However, such control mechanism can only partially fulfill the desired objectives owing to the inertia of the control circuit, and additionally makes the final product more expensive.

SUMMARY OF THE INVENTION

Thus, from what has been explained above it should be apparent that this particular technology is still in need of apparatus for drying fluent materials which is not associated with the aforementioned drawbacks and limitations of the prior art proposals discussed above. Hence, it is a primary object of the present invention to provide an improved construction of apparatus for drying fluent materials which is not associated with these drawbacks and which effectively and reliably fulfills the existing need in the art.

Still a further significant object of the present invention relates to an improved drying apparatus or dryer for fluent materials which is relatively simple in construction, extremely reliable in operation, not readily subject to malfunction, requires a minimum of servicing and maintenance and is economical to manufacture.

Yet a further object of the present invention relates to an improved drying apparatus for fluent materials which is designed to make maximum use of the available treatment surface of the treatment compartment, affords a uniform treatment of the material in an efficient and reliable manner, and does not require complicated and expensive controls to achieve the desired treatment effect.

Now in order to implement these and still further objects of the invention, which will become more readily apparent as the description proceeds, the inventive apparatus for drying fluent materials embodies an approximately horizontally arranged substantially cylindrical thermal treatment compartment as well as a rotor rotating internally of the thermal treatment compartment. The rotor carries vane-like elements operatively associated with or proximate to the inner wall of the treatment compartment. In particular, the rotor carries a number of such elements which are arranged in succession in the direction of rotation of the rotor and serve for wiping, circulating, comminuting and scraping of the material undergoing treatment. One of the elements is at least constructed as a wiper element and another one of the elements is at least constructed as a scraper element. The free edge of the scraper element is situated more closely to the inner wall of the treatment compartment than the free edge of the wiper element. The scraper element is provided with throughflow openings for the scraped material.

By virtue of the inventive design and arrangement of the treatment elements at the rotor of the dryer there is achieved the effect that with variable starting moisture content of the material there is obtained a final product of practically constant moisture content. This constant final moisture of the material can be attained in that the material is mechanically prepared in such a manner, i.e. worked into the smallest or smaller material particles and is agitated, so that these small material particles are always again brought, at brief intervals, into contact with the treatment compartment wall, and thus, there is achieved an optimum heat transfer from the wall of the treatment compartment to the material undergoing processing.

The fact that the final moisture content of the material is independent of the rotational speed of the rotor is believed to be apparently based upon the fact that the material particles are propelled under the influence of the centrifugal force against the wall of the treatment compartment. As a result, the liquid adhering to the surface of the material particles is pushed along such surface of the material particles towards the contact point of such particles with the wall of the treatment compartment. This increased liquid concentration at the contact point improves the heat transfer from the wall of the treatment compartment to the material particles, again resulting in an increase in the vaporization efficiency. On the other hand, with an increase in the rotational speed of the rotor the residence time of the material at the treatment compartment is shortened, so that the material is only subjected to the thermal treatment for a short time. These two effects tend to cancel one another over a wide range of changes in the rotational speed and in such a manner that the final moisture content is not influenced by the rotational speed of the rotor.

That the final moisture content is independent of the mass stream can be explained from the following occurrences. The individual material particles, independently of the supplied quantity per unit of time, are prepared by the treatment elements in such a manner and circulated in the treatment compartment such that the quantity of material per unit of time does not exert any influence upon the frequency of contact of the individual material particles with the treatment compartment wall throughout a wide range of the infed quantity of material. Now, since with constant contact frequency of the material particles at the treatment compartment wall per material particle the vaporization of the quantity of liquid remains constant there is obtained, independently of the mass stream, a product with approximately constant final moisture content.

These different improvements in the treatment of the material are based upon the effect of an increased heat transfer between the treatment compartment wall and the material to be treated and could not be readily expected. Apart from the obtained improvement of the material as concerns the constant final moisture content it is also possible to dispense with the previously required control systems when utilizing the inventive dryer. As a result, there is obtained a noticeable reduction in the maintenance costs of the dryer as well as the production costs of the dried substances or materials.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above, will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. 1 is a schematic view of a thin-film dryer designed according to the teachings of the present invention;

FIG. 2 is a cross-sectional view of the dryer depicted in FIG. 1, taken substantially along the line II—II thereof, and showing a first embodiment of rotor construction employed therein;

FIG. 3 is a cross-sectional view similar to the showing of FIG. 2, illustrating a second embodiment of construction of rotor;

FIG. 4 is a schematic view of a further embodiment of thin-film dryer similar to the showing of FIG. 1;

FIG. 5 is a cross-sectional view of the dryer depicted in FIG. 4, taken substantially along the line V—V thereof;

FIGS. 6 to 9 inclusive schematically illustrate, on an enlarged scale, different constructional embodiments of treatment elements arranged at the rotor depicted in FIG. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawings, the exemplary embodiment of apparatus for drying fluent materials as depicted in FIG. 1 has been generally indicated by reference character **10.** This drying apparatus **10,** a so-called thin-film dryer, possesses an approximately horizontally arranged conduit or pipe **12** connected at one end to a supply compartment or space **14** and at the other end to a discharge compartment or space **16.** At the free end of the supply compartment **14** there is additionally arranged a vapor compartment or space **18,** the free end of which is closed by a cover **19** or equivalent structure. The free end of the discharge compartment **16** is closed by a cover **17.**

The conduit portion forming the supply compartment **14** is equipped with a radially extending connection or stud **20.** The discharge compartment **16** possesses a connection or stud **22** at its associated conduit surface or jacket. Consequently, the conduit **12,** i.e., the inner wall of the jacket **26,** constitutes a heat exchange surface upon which fluent material is processed. Similarly the jacket of the vapor compartment **18** has associated therewith a connection or stud **24.**

The conduit **12,** the supply compartment **14** as well as the discharge compartment **16** are surrounded by a heating or cooling jacket **26,** sometimes conveniently referred to as a heat transfer jacket, which is provided with an inlet connection **28** and an outlet connection **30.** Similarly a heat transfer jacket, either a heating or cooling jacket **32** surrounds the vapor compartment **18,** wherein the jacket **32** possesses an inlet connection **36** and an outlet connection **34.**

A rotor designated by reference character **40** is suitably rotatably arranged in the thin-film dryer **10.** This rotor **40** possesses a rotor core **42** which extends over the entire length of the discharge compartment **16,** the conduit **12,** the supply compartment **14** and the vapor compartment **18,** and such rotor **40** and its rotor core **42** are arranged coaxially within conduit **12.** A multiple-purpose element **44** for wiping, circulating and comminuting the material to be treated is arranged at a partial section **42** of the rotor core and which is retained at a spacing from the partial core section **42** by a multiplicity of webs **46.**

Under the expression "comminuting" as employed in the context of this disclosure there is to be understood an operation in which material agglomerations or the like, as such arise during drying of wet or semi-moist materials, are again redistributed into the original material particles or grains.

The element **44** extends up to the direct region of or proximate to the wall of the conduit **12.** It has been found to be especially advantageous if the width of the multiple-purpose element **44** which is in the form of a multiple-purpose blade corresponds approximately to 0.01 to 0.05—times the diameter d of the conduit **12** (cf. reference character g of FIG. **2**). Viewed in the direction of rotation of the rotor **40** the multiple-purpose element **44** is rearwardly flexed, as best seen by referring to such FIG. **2.** As also best recognized by referring to FIGS. **2** and **8** the angle which the radial web **46** encloses with the element **44** is in the order of between 40° and 80°, preferably 60°. The gap, such as the gap h of FIG. **2,** provided between the inner wall of the conduit **12** and the confronting lengthwise edge of the multiple-purpose element **44** corresponds approximately to 2 to 3—fold the grain or granulation size of the material to be treated.

Arranged diametrically opposite the multiple-purpose element **44** upon the core portion **42** of the rotor is a scraper element **48** which is connected via a blade or leaf spring **50** with the core portion **42.** In this regard it should be mentioned that it has been found to be advantageous if the blade spring **50** is arranged such that, viewed in the direction of rotation of the rotor **40,** it extends rearwardly from the connection location of the blade spring **50** with the core portion **42.** The advantages of this measure shall be explained more fully hereinafter. The scraper element **48** is connected by rivets **51** with the blade spring **50**. A gap f (FIG. 9) having a play corresponding approximately to that of a running shaft i.e. running clearance is provided between the inner wall of the conduit **12** and the confronting edge of the scraper element **48**.

At the region of the supply compartment **14** the corresponding core portion of the rotor **40** has been designated by reference character **52**. In this region a helically-shaped and wound band **54** is secured to the rotor core portion **52**, the outermost edge of which extends up to the region of the wall of the supply compartment **14**, as shown.

The rotor core portion penetrating into the vapor compartment has been designated by reference character **60**. Also at this region there is arranged at such rotor core portion **60** a helically-shaped and wound band **62** which is provided over its entire length with throughpassage holes or apertures **64**. The significance of such throughpassage holes **64** will be explained more fully hereinafter.

The rotor **40** is rotatably mounted at both of its ends in bearings **68** and **70** arranged at the covers **17** and **19** respectively and is operatively connected with any suitable drive **72**.

During operation of the thin-film dryer the rotor **40** is placed into rotation by drive **72**. At the same time a heat carrier, for instance in the form of water vapor, is delivered to the jackets **26** and **32**, in this case constituting heating jackets via the connections **28** and **36** for heating the conduit **12**. The temperature of the heat carrier is regulated in accordance with the desired final moisture content of the material to be treated. In this regard care need only be taken to ensure that the heat carrier is delivered at a constant temperature to the heating jackets **26** and **32**.

The fluent material to be processed, and under which there is to be understood a liquid material (for instance a salt solution), or a pasty-like material (for instance a clay-like or muddy-like material), or a pulverulent material (for instance a granulate or centrifuged product) is infed via the connection **20** into the supply compartment **14**. The wound band **54** engages the material and displaces such in the direction of and towards the discharge connection **22**. As soon as the material has arrived at the operable zone of the multi-purpose or multiple-purpose element **44** it is engaged thereby and distributed in the form of a thin-film. It so doing, the treated material forms at the front side of the element **44** a nose or bowed wave which increases in volume for such time until it can flow away over the inner edge of the multiple-purpose element **44**. During this collection of material the material uniformly distributes at the front side of the multiple-purpose element **44** and thereafter, following the flowing thereof over the inner edge thereof, uniformly falls onto the inner wall of the conduit **12**. The material remains resident at this location for such length of time until it is scraped away from the inner wall by the scraper element **48**. Due to the rotational velocity of the scraper element **48** and the narrow gap between the scraper element **48** and the inner wall of the treatment compartment the adhering material is completely propelled away therefrom without the scraper element **48** coming into direct contact with the inner wall.

During operation of the thin-film dryer material collects at the front of the scraper element **48**. As a result a pressure is exerted upon the scraper element **48**. This pressure, owing to the resilient action of the blade spring **50** brings about a turning or pivoting-in of the scraper element **48** towards the rotor core portion **42**, so that the material can flow through beneath the treatment edge of the scraper element **48**.

The material which has been left by the scraper element **48** at the wall of the conduit **12** will be newly engaged by the multiple-purpose element **44** during the next half rotation of the rotor **40**. Any possible agglomerations or conglomorates of dried material are engaged by the inclined arranged element **44** and pressed towards the gap h (FIG. 2). Owing to this action the occurring material-agglomerations are initially compacted, but nonetheless immediately thereafter comminuted. Consequently, the material to be treated is always maintained in a pulverulent or pasty condition.

In order to promote conveying away of the material collected in front of the scraper element **48** it is advantageous to interrupt, at axial spacing, both the scraper element **48** as well as also the blade spring **50** as such has been best shown by referring to FIG. **1**. Between the cut-out portions **53**, of FIG. **1**, the dammed-up material can flow away laterally and once again be engaged by the next successive element **44**.

The advancing movement of the material from the connection **20** to the connection **22** is achieved by the conveying action of the wound band or strip **54**, so that the material at the region of the conduit **12** is conveyed towards the discharge connection **22** by the continuously further advanced or displaced material.

In order to prevent that treated material remains at the compartment wall at the region of the discharge compartment **16** there is provided at such region the wound band or strip **58** which continuously conveys back from the closure wall **17** material present at the discharge compartment **16** towards the discharge connection **22**.

The vapor formed during treatment of the material in the conduit **12** flows, in countercurrent flow with regard to the flow of the treated material, towards the supply compartment **14**, flows therethrough and arrives at the region of the vapor compartment **18**. The vapors which flow into the vapor compartment **18** impact against the wound band or strip **62** where they are freed of any possibly entrained droplets owing to the prevailing deflection action. The bores or apertures **64** facilitate passage of the droplet-free vapor stream to the region of the vapor connection or outlet **24**, through the agency of which the vapors are delivered for instance to a non-illustrated condenser.

A further constructional form of dryer apparatus of the type described in FIGS. **1** and **2** has been shown in FIG. **3**. In this embodiment there are provided two multiple-purpose or multi-purpose elements **44**, these two elements **44** being arranged in diametrically opposed relationship at the rotor core portion **42**. As illustrated, these elements **44** are held by webs **46** at a spacing from the rotor core portion **42**. A pair of scraper elements are provided in a position displaced 90° with regard to the multiple-purpose elements **44**. These scraper elements **48** are also arranged in diametrically opposed relationship with regard to one another at the rotor core portion **42**. Scraper elements **48** are secured by rivets **51** or equivalent fastening devices to blade springs **50** which are connected with the rotor core portion **42**. Owing to this combination there is achieved an improvement in the treatment of the material in relation to the arrangement depicted in FIG. 2.

In FIG. 4 there is illustrated a further embodiment of inventive apparatus. Here, in the conduit **12** which is surrounded by a heat transfer jacket i.e. a heating or cooling jacket **26**, there is coaxially arranged rotor **40**. At the core portion **42** of the rotor **40** there are arranged four different elements **80, 82, 88** and **48**, wherein each such elements are arranged offset by 90° with regard to one another.

The elements **48, 80, 82** and **88** depicted in FIGS. **4** and **5** have been individually shown in a larger view in FIGS. **6** to **9**. The wiper element **80** extends axially over the entire length of the associated partial section or core portion **42** of the rotor core and radially up to the region of the wall of the conduit or pipe **12**. A gap *a*, as best seen by referring to FIG. **6**, is provided between the wall of the conduit **12** and the confronting edge of the wiper element **80**, this gap corresponding in size to the desired film or layer thickness of the material to be treated.

The circulating element **82** which follows the wiper element **80** looking in the counterclockwise direction, is designed in the form of a band or strip **82** and likewise extends axially over the entire length of the partial section **42** of the rotor core, and wherein the radial extent C of the band **82** corresponds approximately to 0.001 to 0.03 -fold of the diameter *d* (FIG. **7**). As also clearly seen by referring to FIG. **7** the gap *b* between the wall of the conduit **12** and the edge of the band **82** confronting the aforementioned conduit wall corresponds approximately to the play of a running shaft, i.e. running clearance. The band **82** is retained by webs **84** at a spacing from the rotor core **42**.

The comminution element **88** which follows the material circulation element **82** extends with its flexed portion **86** up to and towards the inner wall of the conduit **12**. The flexed end portion **86** of the comminution element **88** confronting the inner wall of the conduit **12**, viewed in the direction of rotation of the rotor, is flexed or bowed towards the rear, and wherin this end portion **86** serves to comminute the material to be treated. On the other hand, and as already described in conjunction with FIG. **2**, the scraper element **48** is secured to a blade spring **50** or the like which, in turn, is connected with the rotor core portion **42**. The scraper element **48** and the blade spring **50** are connected with one another by rivets **51** or other suitable attachment or fastening devices.

In this embodiment the material fed into the thin-film dryer is engaged by the wiper element **80**, and wherein all of the material must flow through the gap *a* which is bounded, on the one hand, by the edge of the wiper element **80** confronting the inner wall of the conduit **12** and, on the other hand, by the inner wall of such conduit itself. The material **92** which is spread or wiped uniformly upon the inner wall of the conduit **12** is subsequently engaged by the band or strip **82** and intensively admixed or agitated, the agitated material flowing over the inner edge of the band **82** and again falling onto the inner wall and there remaining in the form of markedly agglomerated portions **96**. The comminuting element **88** following the band **82** now engages the agglomerated or conglomerated material **96** by means of its flexed end portion **86**, and wherein there occurs between the end portion **86** and the inner wall of the conduit **12** a compaction of the materials with simultaneous comminution of the agglomerations or conglomerates. At the same time the material is again uniformly distributed upon the inner wall in the form of a thin layer **100**. In order to assist the distribution action and to prevent possible collection of material at the end portion **86** of the comminution element **88** it is advantageous to interrupt the comminution element **88**, as viewed in the axial direction of the rotor, at regular intervals or spacing. In this regard attention is invited to FIG. **4**. Hence, as best recognized by referring to FIGS. **1** and **4** any collection of material between the thus present openings **53** can again deposit upon the inner wall of the conduit **12** and be engaged by the next successive scraper element **48**. However, under certain circumstances it also can be advantageous to construct the comminution element **88** to be continuous or uninterrupted.

It has been found to be advantageous if the end portion **86** encloses with the radial remaining portion of such comminution element **88** and angle α between 40° and 80°, most preferably an angle of 60°. In this regard attention is invited to FIG. **8**. By also referring to this Figure it should be recognized that the gap *e* between the inner wall of the conduit **12** and the free edge of the end portion **86** confronting such inner wall advantageously amounts to 2 to 10-fold the granulation or grain size of the material undergoing treatment.

The function of the scraper element **48** depicted in FIG. **8** corresponds to that of the scraper blade **48** described in conjunction with the embodiment of FIG. **2**. With the arrangement of the scraper element **48** it is of particular significance that it is approximately radially arranged in the conduit **12**, and wherein it forms with a tangent at the conduit a right angle β, as best seen by referring to FIG. **9**. It should be also understood by referring to FIG. **9** that the gap *f* between the wall of the conduit **12** and the therewith confronting lengthwise edge of the scraper element **48** approximately corresponds to the running play or clearance of an appropriate shaft of the same diameter.

Finally, it might be mentioned for the various embodiments disclosed herein that the blade spring **50** and the scraper element **48**, viewed in the axial direction of rotation of the rotor, may possess the same length.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims. Accordingly,

What is claimed is:

1. An apparatus for drying fluent material comprising an approximately horizontally arranged substantially cylindrical conduit defining therein an internal compartment and having a material inlet and material outlet, said conduit including a heat exchange surface confronting said compartment, means arranged within said conduit for conveying infed material therethrough, a rotatable motor arranged within said internal compartment, a plurality of elements which follow one another in the circumferential direction of rotation of said rotor and angularly offset from one another and carried by said rotor, said plurality of elements serving for the wiping, circulation, comminution and scraping of the material, one of said elements being constructed at least as a wiper element and another of said elements being constructed at least as a scraper element, said wiper element and said scraper element each having a respective free edge, the free edge of the scraper element being positioned closer to said heat exchange surface of said conduit than the free edge of the wiper element, said scraper element being provided with throughflow openings for scraped material.

2. The apparatus as defined in claim **1**, wherein said scraper element defines a multi-purpose element which extends substantially over the entire length of said conduit and contains means for comminuting and circulating the material, said scraper element containing means for scraping the treated material from said heat exchange surface of said conduit.

3. The apparatus as defined in claim **2**, wherein said multi-purpose element extends up to the region of said heat exchange surface of said conduit and extends radially only over a portion of the free space of said conduit, said multi-purpose element, viewed in the direction of rotation of the rotor, being flexed towards the rear.

4. The apparatus as defined in claim **3**, wherein the width of the multi-purpose element approximately corresponds to 0.01 to 0.05 -fold of the diameter of the conduit.

5. The apparatus as defined in claim **3**, further including radially extending webs for securing said multi-purpose element to said conduit, said flexed multi-purpose element enclosing with said radially extending webs an angle which is in a range between 40° and 80°.

6. The apparatus as defined in claim **5**, wherein said angle amounts to 60°.

7. The apparatus as defined in claim **2**, further including blade spring means connected with the rotor, said scraper element being secured to said blade spring means.

8. The apparatus as defined in claim **7**, wherein said scraper element is radially arranged within said conduit.

9. The apparatus as defined in claim **7**, wherein said blade spring means and said scraper element, viewed in the axial direction of said rotor, possess the same length.

10. The apparatus as defined in claim **7**, wherein said rotor has a rotor core to which there is secured said blade spring means, said blade spring means, viewed in the direction of rotation of said rotor, extending rearwardly from the connection location of the blade spring means with said rotor core.

11. The apparatus as defined in claim **7**, wherein a running clearance is provided between said heat exchange surface of the conduit and the confronting lengthwise edge of the scraper element.

12. The apparatus as defined in claim **2**, wherein there is provided a further multi-purpose element and a further scraper element, said respective two multi-purpose elements and two scraper elements being arranged as substantially oppositely situated pairs at said rotor.

13. The apparatus as defined in claim **1**, wherein said elements define a respective element seated upon said rotor for wiping, circulating, comminuting and scraping of the material from said heat exchange surface of the conduit.

14. The apparatus as defined in claim **13**, wherein the element provided for wiping comprises an axially extending wiper element which extends approximately over the entire length of the conduit.

15. The apparatus as defined in claim **13**, wherein said element provided for circulating the material comprises a band extending approximately over the entire length of the conduit, said band, starting from the region of said heat exchange surface of the conduit, extending in radial direction only over a portion of the free space of the conduit.

16. The apparatus as defined in claim **15**, wherein the band is arranged such that a running clearance is left free between said heat exchange surface of the conduit and the confronting lengthwise edge of the band.

17. The apparatus as defined in claim **15**, wherein the radial extent of said band corresponds to 0.001 to 0.03 -fold of the diameter of the conduit.

18. The apparatus as defined in claim **13**, wherein the element serving to comminute agglomerations of material comprises a vane-like element with axial interruptions and extending over substantially the entire length of the conduit, the end portion of said comminuting element confronting said heat exchange surface of the conduit, viewed in the direction of rotation of the rotor, being flexed towards the rear.

19. The apparatus as defined in claim **18**, wherein the flexed portion of the vane-like element encloses an angle between 40° and 80° with the remaining portion of the vane-like element.

20. The apparatus as defined in claim **19**, wherein said angle amounts to 60°.

21. The apparatus as defined in claim **13**, wherein the element for scraping the material from said heat exchange surface of the conduit comprises a scraper element which, viewed in the direction of rotation of the rotor, is secured to a resilient element which extends rearwardly from the connection location with the rotor core, said scraper element being arranged approximately radially within the conduit and having a running clearance between said heat exchange surface of the conduit and the confronting lengthwise edge of the scraper element.

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