United States Patent

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[73] Assignee **Luwa Ag.**
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[33] **Switzerland**
[31] **13,603/68**

[54] **ROTOR CONSTRUCTION OF THIN FILM TREATMENT APPARATUS**
12 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** ..... **159/6 W,** 159/13
[51] **Int. Cl.** **B01d 1/22**
[50] **Field of Search** ..... 159/6 W, 6 WH; 202/236, 89; 29/150, 15; 156.8 B, 157.3 B, 400, 455, 470, 471.3

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ABSTRACT: There is disclosed a rotor for a thin film treatment apparatus which incorporates a central tubular body and a number of axially and radially extending rotor blades arranged about the periphery thereof. The edges of the rotor blades confronting the tubular body possess connection tongues, or equivalent structure, which are connected, for instance by welding, with the surface of the tubular body. According to an important aspect of the invention at least a part of the connection tongues, externally of the planes containing the side surfaces of the associated rotor blades are connected with the tubular body, and further, the rotor blades exhibit invented spaces arranged spaced from one another in the lengthwise direction. More specifically, these indented spaces extend centripetally over a portion of the radial width of the associated rotor blade from the lengthwise extending edge of such rotor blade facing away from the tubular body.

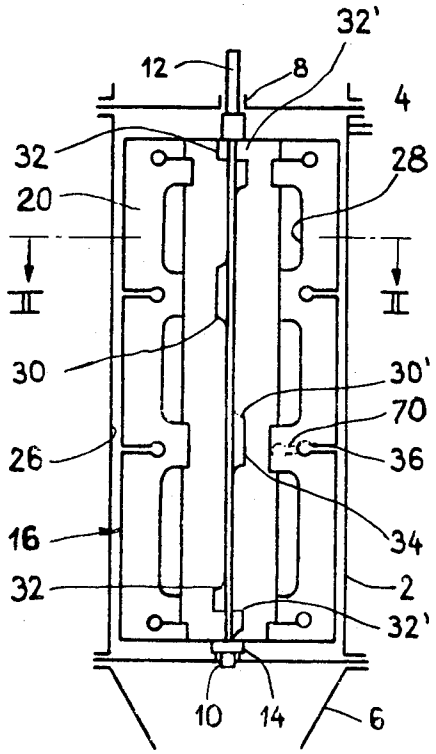


Fig 1

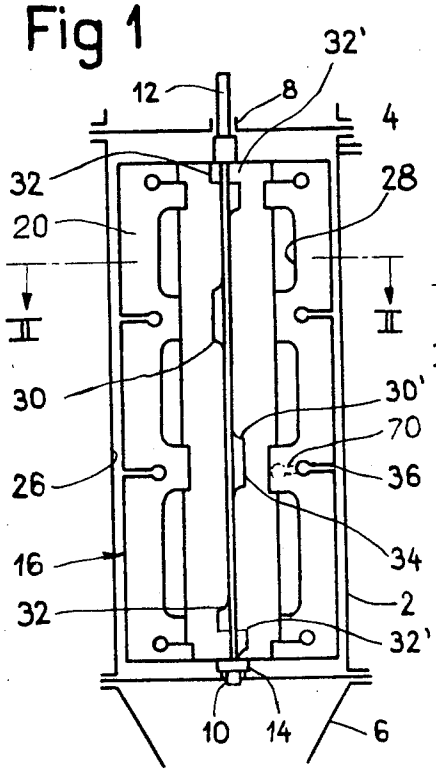
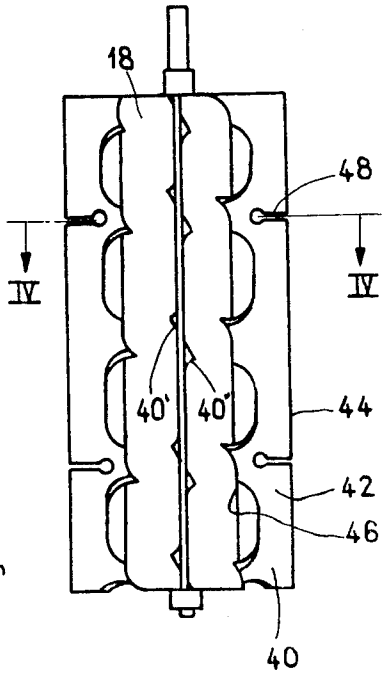


Fig 3



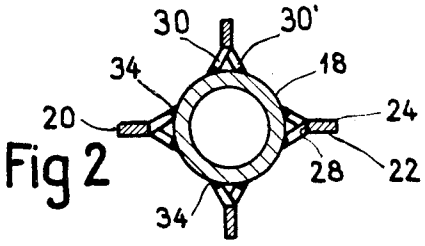


Fig 2

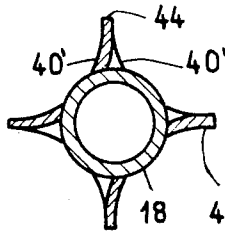


Fig 4

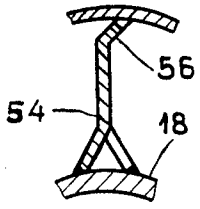


Fig 5

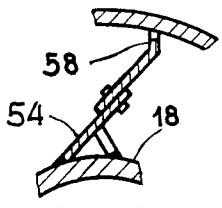


Fig 6

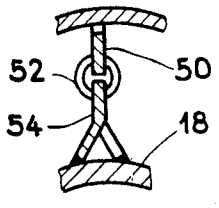


Fig 7

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BY Jacobi, Davidson & Klauer

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ROTOR CONSTRUCTION OF THIN FILM TREATMENT APPARATUS

BACKGROUND OF THE INVENTION

The present invention broadly relates to thin film treatment apparatus and, more specifically, deals with an improved rotor construction for such a thin film treatment apparatus.

A known physical construction of rotor for thin film treatment apparatus consists of a central tubular body which is rotatably supported at its ends in the housing of the treatment apparatus. A drive shaft is coupled with one end of the central tubular body. Further, a plurality of rotor blades which are spaced about the periphery of the rotor body extend in the lengthwise direction thereof. These rotor blades generally protrude radially from the rotor body, the radially disposed lengthwise edges of such blades serving to distribute or wipe the material to be treated in a thin layer upon the generally cylindrical inner wall of the apparatus of the housing. The rotor blades are flushly connected by welding with the tubular body along their radially inwardly disposed edges. Even though the general construction of such rotors is relatively simple, still, the costs of manufacturing same is nonetheless quite expensive. First of all, the rotor blades must be welded at the edges neighboring the tubular body along the entire length at the outer or peripheral surface thereof. This is necessary in order to fill the gap therebetween, and specifically, to prevent any penetration of treatment material into this gap. Even though accessibility to the welding seams is quite difficult these welding seams must nonetheless be produced such that they are practically free of pores, and this operation is correspondingly expensive.

A rotor construction is also known to the art in which the rotor blades are welded through the agency of connection tongues with the tubular body. In this arrangement, the radially inwardly directed edge portions of the rotor blades disposed between the connection tongues are spaced from the surface of the tubular body. Hence, the expenditure of labor during welding of rotor blades to the tubular body is much less, since the welding seams are appreciably shorter. Although treatment material can indeed penetrate into the slots between the surface of the tubular body and the edges of the rotor blades confronting such tubular body, still, cleaning of the slots is readily possible since they possess a certain width. In the known constructions of rotors, of the type wherein the rotor blades are welded with the tubular body through the agency of connection tongues, one particular difficulty is readily noticeable, which basically, is also present in rotors in which the rotor blades are welded throughout their entire length with the tubular body. Specifically, the stresses which result in the rotor blades during operation, and which can assume quite considerable values during wiping of viscous media at the treatment wall, reach their maximum at the attachment locations, that is to say, at those cross-sectional regions in which these rotor blades are welded with the tubular body. The welding seams are therefore subjected to pronounced loads. The same is also true for the cross-sectional region of the rotor blades which directly neighbor the welding seams, the joints of which sometimes are changed in an unfavorable way due to the welding operation and exhibit a reduced strength.

SUMMARY OF THE INVENTION

Therefore, there is a real need in the art for a rotor construction which overcomes the aforementioned drawbacks of the prior art structures. Accordingly it is a primary object of the present invention to provide an improved rotor construction for thin film treatment apparatus which effectively overcomes these prior art disadvantages.

Yet, another more specific object of the present invention relates to an improved rotor construction having a unique and novel method of attachment of the rotor blades to the rotor body member.

Still a further significant object of the present invention relates to an improved construction of rotor assembly for a thin film apparatus which is relatively simple in construction, can be manufactured at reasonable cost, does not require any complicated or unwieldy manufacturing operations, is extremely reliable in operation, and specifically, prevents the occurrence of the problems enumerated above and experienced with the prior art constructions.

Now, in order to implement these and still further objects of the invention, which will become more readily apparent as the description proceeds, it will be understood that the inventive rotor is of the type incorporating a substantially central tubular body and a plurality of rotor blades arranged at the circumference of such tubular body, these rotor blades extending in the lengthwise direction of said tubular body. Each of the rotor blades possesses a lengthwise extending edge which confronts the tubular body and possesses connection tongue means, or equivalent structure, connected with the surface of the tubular body. According to an important facet of the invention, at least a portion of the connection tongue means of the associated rotor blade are connected with the tubular body externally of the planes containing the side surfaces of the associated rotor blade. Moreover, each of the rotor blades possesses cutout portions which are spaced in lengthwise direction from one another and which extend over a portion of the width of the associated rotor blade from the lengthwise extending edge of such associated rotor blade facing away from the tubular body.

BRIEF DESCRIPTION OF THE DRAWING

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 drawing wherein:

FIG. 1 schematically depicts a longitudinal sectional elevational view of a thin film treatment apparatus equipped with a rotor designed according to a first embodiment of the present invention;

FIG. 2 is a sectional view of the rotor construction depicted in FIG. 1, taken along the line II–II thereof;

FIG. 3 is an elevational view of a second embodiment of rotor construction according to the invention;

FIG. 4 is a sectional view of the rotor construction depicted in FIG. 3, taken along the line IV–IV thereof; and

FIGS. 5 to 7 inclusive show three different respective forms of rotor blades at their wiper portion.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Describing now the drawings, and, more specifically, directing attention to the exemplary embodiment of thin film treatment apparatus, for instance a thin film evaporator, depicted in FIG. 1, it will be recognized that such embodies a housing **2** having an infeed connection or stud **4** for the influx of material to be treated. The treated material leaves the apparatus housing **2** at a substantially funnel-shaped lower portion **6** from where it is withdrawn. The rotor member, generally designated by reference numeral **16**, is supported at the stub shafts **12** and **14** in suitable bearing means **8** and **10**, respectively. This rotor **16** possesses a substantially centrally arranged cylindrical tubular body member **18** extending coaxially with respect to the stub shafts **12** and **14** and rigidly connected therewith.

About the periphery of the rotor body **18** there are uniformly arranged a number of rotor blades, and in this specific arrangement it will be seen that four such rotor blades **20** are provided. These rotor blades **20** extend in the lengthwise direction of the tubular body member **18** and, further, incorporate blade portions **22** which protrude in the radial direction from the rotor body member. Further, it will be recognized that the lengthwise edges or marginal portions **24** of the blade portions **22** facing away from the tubular body

member **18** serve for distributing the treated material upon the generally cylindrical inner wall **26** of the housing **2** of the thin film treatment apparatus. On the other hand, the lengthwise extending edges **28** of the blade portions **22** confronting the tubular body member **18** incorporate or possess connection tongues **30** and **30'** and **32** and **32'**, respectively. It will be understood that in the context of this application the term "connection tongues" is used in its broader sense as describing attachment means, which may be in the form of tongues, tabs, flaps, or the like. Continuing, it will be recognized that these connection tongues **30** and **30'** are flexed or bent with respect to the planar or flat blade portion **22** to opposite sides. The same is also true of the connection tongues **32** and **32'**. Additionally, it will be seen that a respective pair of these connection tongues **32** and **32'** is provided at each of both ends of a rotor blade **20**, whereas the connection tongues **30** and **30'** are distributively arranged between the ends of the associated blade uniformly over the length of such rotor blade **20**. In the embodiment illustrated in FIGS. **1** and **2**, it will be observed that one of each such connection tongues **30** and **30'** is provided. These connection tongues **30** and **30'** and **32** and **32'**, respectively, are connected, typically by welding, with the tubular body member **18** along linearly directed and axially parallel edges **34**. Furthermore, it should be understood that according to a significant feature of the present invention these edges **34** are situated externally of the planes defining or containing the side faces or surfaces of the blade portions **22**. Additionally, it will be seen that cutout portions or grooves **36** are provided at the free lengthwise edges **24** of each of the blade portions **22**, these cutout portions **36** being distributively arranged, as shown, over the length of such associated blade portion. More specifically, it will be observed that these cutout portions or indented spaces **36** are, in each instance, located at the region of a connecting tongue **30** and **30'**, respectively, and further, extend perpendicular to the associated lengthwise blade edge **24** over the width of the blade portion **22**, as shown. In fact, such cutout portions can extend up to the root portion of the associated connection tongues **30, 30'** as shown at **70**.

Now the described physical construction of rotor for the depicted thin film apparatus possesses a number of different notable advantages. First of all, with sufficient flexure or angulation of the connecting tongues **30** and **30'** and **32** and **32'**, respectively, relative to one another it is possible to displace the cross section in which the greatest stresses occur from the welding edge **34** into the plane of the edges or marginal portions **28**, in which the connection tongues transform or merge with the blade portion **22**. Consequently, the greatest loading of the rotor blades, fabricated from continuous sheet metal of uniform thickness, occurs at a region or portion which has not experienced any considerable thermal loading by virtue of welding with the tubular body. As a result, the danger of rupture or fissure formation is considerably reduced. Notwithstanding these properties it is only necessary to provide relatively few and short welding seams, in order to secure the rotor blades to the tubular body member **18**. Owing to the angulation or bending of the connection tongues there also is provided the notable advantage that the welding edges **34** are readily accessible even when utilizing a relatively large number of blades distributed about the periphery of the tubular body, and therefore the welding seams can be produced relatively easily. It has been found that with the same strength as compared with known constructions the inventive construction enables a saving in material and a reduction in weight.

The relatively deep cutout portions or indented spaces **36** provided at the zones of the connecting tongues **30** or **32** prevent the occurrence of longitudinal stresses at the tubular body **18** due to relatively great expansion of the rotor blades **22** along their free marginal edges **24**. The dreaded warping or bending of the tubular body, attributable to the relatively high material temperatures at the region of the treatment wall **26**, can thus be faultlessly prevented.

The second embodiment of rotor construction depicted in FIGS. **3** and **4** differs from that shown in FIGS. **1** and **2** primarily in the manner in which the connection tongues or flaps **40** are all of the same construction. Whereas, furthermore, with the embodiment of FIGS. **1** and **2** the connection tongues **30, 30'** and **32, 32'** were flexed or bent about an axis parallel to the lengthwise edges **24** and **28**, in this embodiment the connection tongues or flaps **40** are bent out of the plane of the blade portion **42** about an axis extending perpendicular to the lengthwise edges **44**. Consequently, the welding seams **46** of the connection tongues or flaps **40** extend upon the outer surface of the tubular body **18** along a helical line. Each connection tongue **40** possesses a portion **40'** and a further portion **40''**, which, with respect to the blade portion **42**, extend to opposite sides, in other words are disposed externally of the planes containing the respective side faces or surfaces of the blade portion **42**. Hence, the associated portions of the welding edges **46** are also located outside of the mentioned planes. Once again, it will be observed that portions or indented spaces **48**, or equivalents, are provided at the blade portion **42** of each blade, these cutout portions, insofar as construction, arrangement and function, corresponding to the cutout portions **36** of the preceding embodiment of FIGS. **1** and **2**.

Here also the rotor construction of the embodiment of FIGS. **3** and **4** provides essentially the same advantages as attributed to the embodiment of rotor depicted in FIGS. **1** and **2**. Once again, it is possible to especially, here also, considerably reduce the specific loading of the welding seam and welding edges **46**, respectively, as well as also the directly neighboring cross section.

Now, turning attention to FIGS. **5**, **6** and **7**, respectively, here there are shown three different constructional forms of rotor blades or vanes which, basically, can be secured to the associated tubular body **18** in one of the ways shown, for instance, in the arrangement of FIGS. **1** and **2**. Whereas, with the embodiment of rotor blades or vanes depicted in FIGS. **5** and **6**, respectively, one is dealing with rotor blades of a rigid construction, in the remaining embodiment of FIG. **7** there is shown a wiper blade **50** which can be pivotably connected through the agency of a suitable hinge or articulation ring member **52** with the rigid portion **54** of the associated rotor blade.

Now, as far as all of these arrangements of rotor blades are concerned, as shown in FIGS. **5** to **7** inclusive, it will be understood that the wiper blade portion **56** of FIG. **5** which is flexed with respect to the rigid blade portion **54**, and similarly the wiper blade portion **58** of the blade arrangement of FIG. **6**, as well as also the hingedly connected wiper blade portion **50**, articulated in FIG. **7** to the rigid portion **54** of the rotor blade by means of the pivotal hinge connection ring means **52**, are all subdivided in the lengthwise direction, and specifically, in accordance with the cutouts or indented spaces **36** and **48** shown in respective FIGS. **1** and **3** heretofore described. It is naturally also conceivable to provide the rigid portions **54** (FIGS. **6** and **7**) secured to the tubular body with cutouts or the like, which extend radially up to the tubular body **18** and contribute to reductions in stress at such tubular body **18**. It will be seen that such an arrangement of cutout portions or indented spaces which extend up to the root portion of the associated connection tongue means has been shown in phantom lines by reference character **70** in FIG. **1**, but could be equally well provided in any of the other embodiments shown herein except that in the arrangement of FIG. **7** the existence of the hinged connection ring means **52** only necessitates that the cutout portions or indented spaces be provided at the blade portion **54** which is rigidly connected with the tubular body.

It should be apparent from the foregoing detailed description, that the objects set forth at the outset to the specification have been successfully achieved. ACCORDINGLY,

What we claim is:

1. A rotor for a thin film treatment apparatus comprising, in combination, a substantially centrally arranged tubular body

means, a plurality of planar rotor blades having side surfaces and secured to the outer circumference of said tubular body means, said rotor blades extending in the axial direction of said tubular body means, each of said rotor blades having an axially extending outer edge and an axially extending inner edge, said axially extending inner edge confronting but radially spaced from said tubular body means and possessing connection tongue means extending toward said tubular body means out of the planar material of the blade and bent laterally in opposite directions out of the plane of the blade and connected at their innermost ends to the surface of said tubular body means, at least a portion of said connection tongue means of the associated rotor blade being connected with said tubular body means externally of the planes containing said side surfaces, said rotor blades further possessing indented spaces which are spacedly separated in the axial direction and which extend over at least a considerable portion of the radial extent of the associated rotor blade from said axially extending outer edge of said associated rotor blade centripetally toward the tubular body means.

2. A rotor for a thin film treatment apparatus as defined in claim 1, wherein a weld connection serves to secure said connection tongue means to said tubular body means.

3. A rotor for a thin film treatment apparatus as defined in claim 1, wherein said connection tongue means extend from the associated rotor blade to peripherally spaced places on the tubular body means.

4. A rotor for a thin film treatment apparatus as defined in claim 3, wherein each mutually adjacent pair of connection tongue means are arranged spaced from one another in the axial direction of the associated rotor blade and are angled to opposite sides of the rotor blade.

5. A rotor for a thin film treatment apparatus as defined in claim 3, wherein said connection tongue means are angled with respect to the associated rotor blades out of the planes containing said side surfaces thereof.

6. A rotor for a thin film treatment apparatus as defined in claim 5, wherein each of said indented spaces is located at approximately the position of a connection tongue means along the rotor blade.

7. A rotor for a thin film treatment apparatus as defined in claim 6, wherein each indented space extends up to the root region of the associated connection tongue means.

8. A rotor for a thin film treatment apparatus as defined in claim 3, wherein each connection location of said connection tongue means with said tubular body means extends along a substantially helical line at the surface of said tubular body means.

9. A rotor for a thin film treatment apparatus as defined in claim 8, wherein each of said indented spaces is disposed approximately opposite the location of a connection tongue means.

10. A rotor for a thin film treatment apparatus as defined in claim 9, wherein each indented space extends up to the region of the root portion of the associated connection tongue means.

11. A rotor for a thin film treatment apparatus comprising, in combination, a substantially centrally arranged tubular body means, at least one rotor blade having side surfaces and first and second opposed longitudinal edges, said rotor blade being secured to the outer circumference of said tubular body means, said rotor blade extending in the axial direction of said tubular body means, said rotor blade having an axially extending edge defined by said first longitudinal edge confronting but radially spaced from said tubular body means and possessing connection tongue means extending toward said tubular body means to peripherally spaced points on the surface of said tubular body means, at least a portion of said connection tongue means of the rotor blade being connected with said tubular body means at said peripherally spaced points on the surface thereof, said rotor blade further possessing indented spaces which are spacedly separated in the axial direction and which extend over at least a portion of the radial extent of the rotor blade from said second longitudinal edge of said rotor blade toward the tubular body means.

12. A rotor for a thin film treatment apparatus as defined in claim 11, wherein said indented spaces extend over at least one-half of the radial extent of the rotor blade.