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DISCHARGE SECTION FOR ROTARY BLADE THIN FILM PROCESSORS

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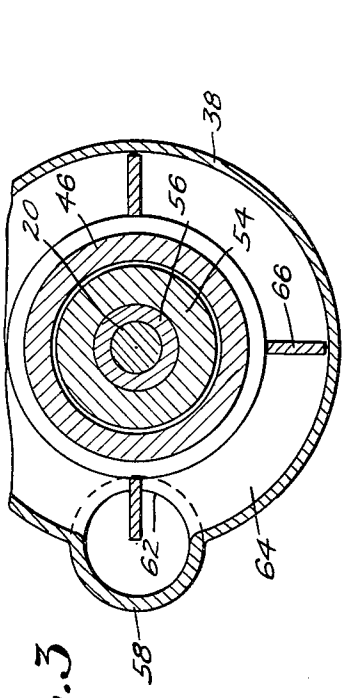


Fig. 3

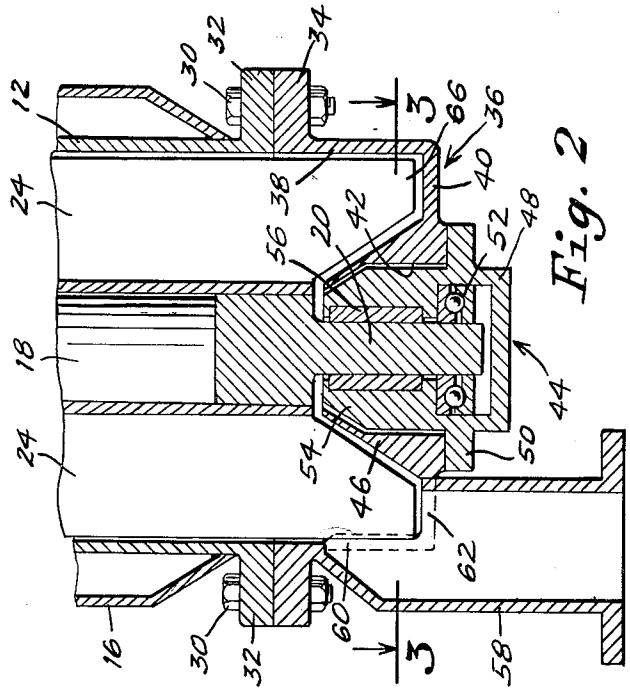


Fig. 2

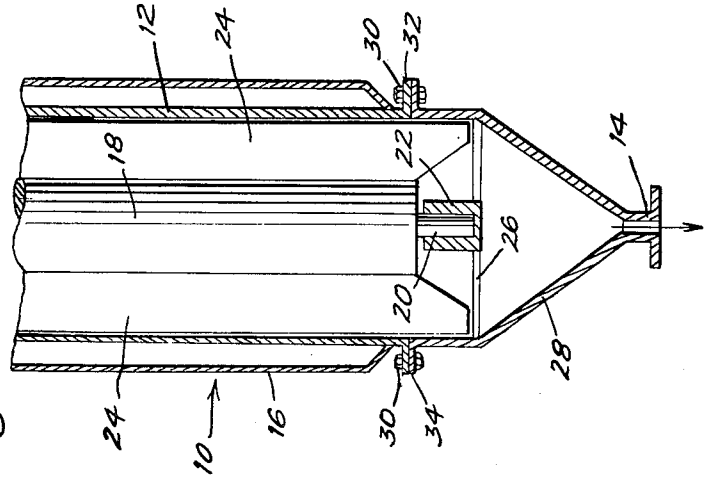


Fig. 1

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DISCHARGE SECTION FOR ROTARY BLADE THIN FILM PROCESSORS

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This invention relates to thin film thermal processors and more particularly to an improved product discharge section for such processors.

Thin film thermal processors are well known and are commonly used in processes of evaporation and distillation as well as for heat or mass transfer purposes. In such processes, the liquid feed material is introduced at the top of an externally heated hollow cylinder, flows down the inside wall of the cylinder by gravity and is operated on by a concentric bladed rotor.

The present invention relates to an improved product discharge arrangement at the bottom of the apparatus capable of discharging very viscous products. The construction of the present invention makes it possible to locate the lower rotor bearings close up to the rotor but outside of the processing atmosphere away from danger of damage by product entry into the bearings.

Product outlet sections commonly used are of two general types. One type is described in U.S. Patent No. 2,774,415 and relates to an inside bearing of the dry or water lubricated type close up to the rotor with a spider carrying the bearing assembly and a conical product collector and discharge section below the bearing. The second or outside bearing type includes a conical or dish-shaped collector at the bottom of the processor, a long rotor shaft extending down through the bottom of the collector into anti-friction bearings mounted below the collector and a product discharge pipe mounted eccentrically of the collector to drain off the collected products. While entirely suitable for some applications, both types of product outlet sections have certain disadvantages.

With the inside bearing construction, it is usually impossible to use long life anti-friction bearings because of temperature and vacuum conditions often encountered in the thermal processor equipment. Carbon or plastic bearings must be run dry or lubricated with a flow of water or some other fluid compatible with the temperature and chemical conditions of the process. Very viscous products tend to build up on the spider supporting the bearings or even bridge over the openings through the spider. Similarly, very viscous materials tend to bridge any conical or dished collector below the bearing spider, thus failing to flow out of the discharge pipe properly.

The outside bearing construction requires the use of a long rotor shaft with consequent cost and vibration problems, special bearing seals to protect against product entering into the bearings, and requires an offset or eccentric discharge pipe location into which viscous materials do not readily flow.

Through the novel construction of the present invention, it is possible to utilize anti-friction bearings closely coupled to the rotor and to permit the free discharge of even viscous treated products by avoiding all converging or restricted flow areas after the product leaves the action area of the rotor blades.

It is therefore a primary object of the present invention to provide an improved thin film thermal processor.

Another object of the present invention is to provide an improved discharge section for thin film thermal processors.

Another object of the present invention is to provide a thin film thermal processor discharge section utilizing anti-friction bearings closely coupled to the end of the rotor.

Another object of the present invention is to provide a thin film thermal processor discharge section capable of readily discharging even viscous products.

These and further objects and advantages of the invention will be more apparent upon reference to the following specification, claims and appended drawings wherein:

FIGURE 1 shows the lower portion or discharge end of a conventional thin film thermal processor;

FIGURE 2 is an enlarged axial cross-sectional view of the improved discharge section of the present invention for thermal processors of the type illustrated in FIGURE 1; and

FIGURE 3 is a horizontal section taken along line 3—3 of FIGURE 2.

Referring to the drawings, FIGURE 1 shows the lower end of a conventional thin film thermal processor of the inside bearing type generally indicated at **10**. Material to be processed is introduced into the cylindrical chamber **12** and flows down the inner surface of the chamber walls under the influence of gravity to be discharged from outlet pipe **14**. A heating fluid such as steam or the like is supplied to the outer jacket **16** and the vapors produced from the processed material are discharged from the top of the processor. A concentric rotor **18** is provided with an upper bearing and seal (not shown) and a lower stub shaft **20** supported in a suitable bearing **22**. Rotor **18** carries blades **24** extending radially outwardly from the rotor **18** toward the cylindrical chamber **12** and terminating with the blade tips in contact with or close to the film of liquid formed on the inner wall surface of chamber **12**. A spider **26** rigidly secured to the conical discharge section **28** at the lower end of the processor supports bearing **22**. The discharge section is suitably bolted to the lower end of chamber **12** as illustrated at **30**.

FIGURES 2 and 3 illustrate the novel discharge section of the present invention particularly suited for thermal processors of the type illustrated in FIGURE 1. In FIGURES 2 and 3, like parts bear like reference numerals. As shown, the lower end of cylinder **12** terminates in a horizontal flange **32** for connection by bolts **30** to a mating flange **34** at the top of a removable end closure generally indicated at **36**.

End closure **36** comprises a cylinder **38** with an inside diameter the same as the inside diameter of chamber **12** formed with an integral bottom plate **40** closing off the bottom of the thermal processor. Bottom plate **40** has a central aperture **42** in which the bearing assembly generally indicated at **44** is mounted. Aperture **42** is surrounded by a conical riser **46** extending several inches above bottom plate **40** and reaching close to the lower end of rotor **18**.

Bearing assembly **44** includes a housing **48** having a horizontal flange **50** rigidly secured by welding or other suitable means to bottom plate **40**. Suitably supported within housing **48** is an anti-friction bearing **52** having its lower race secured to housing **48** and its upper race secured to stub shaft **20** fixedly received in the hollow end of rotor **18**. While rotor **18** may be solid, it is preferably hollow as indicated for the purposes of reducing weight and for economy. Housing **48** also includes an upwardly extending hub **54** retaining a rotary seal **56** in engagement with stub shaft **20**.

At one side of end closure **36** is a vertical discharge pipe **58**. The vertical center line of discharge pipe **58** lies at or near the inner wall of cylinder **38**. The opening to the discharge pipe **58** from end closure **36** consists of a rectangular area in the vertical wall of cylinder **38** indicated at **60** and a semi-circular area in bottom plate **40** indicated at **62**. The semi-circular aperture **62** extends preferably completely across the flat annular surface **64** of bottom plate **40**. Blades **24** extend downwardly into the bottom closure section **36** terminating a short distance above the bottom plate **40** with the

lower portion **66** of each blade clearing bottom plate **40** and conical riser **46** by a small fraction of an inch.

In operation, liquid material flowing down the wall of cylindrical chamber **12** by gravity and with any downward pumping action of the rotor blades continues such downward flow to the wall of cylinder **38** still under the action of the rotor blades. Depending upon the particular blade system used, the material may flow vertically down the wall or in a downward spiral path. Any material moving in a spiral path which reaches rectangular exit **60** in the side wall of cylinder **38** is thrown through this opening into the discharge pipe **58**. Likewise, any material whose downward or spiral flow does not reach this rectangular opening will progress to the bottom plate **40** where it is acted on by the blade ends **66** to be carried around the bottom annular surface **64** to the semi-circular opening **62** and rectangular opening **60**. In this passage, the processed material meets no restricting or blocking surfaces and is continually advanced toward the ultimate discharge point, i.e., pipe **58** by the action of blades **24** irrespective of whether the material passes vertically downwardly or downward in a spiral path. The discharge section thus makes it possible to process materials of extremely high viscosity without danger of clogging.

It is apparent from the above that the present invention provides a novel discharge arrangement for thin film thermal processors which permits the use of long life anti-friction bearings closely coupled to the end of the rotor but which, at the same time, insures against clogging for even highly viscous liquids. The discharge arrangement of the present invention provides for the physical agitation by the blades of the processed material so that the material is carried to discharge pipe **58** irrespective of whether it falls in substantially a vertical direction or whether it falls in a spiral path.

The invention may be embodided in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefor to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. A thin film thermal processor comprising, a heated cylindrical chamber, a rotor carrying a plurality of radially and axially extending blades mounted in said chamber, an end closure at the bottom of said chamber, a discharge opening formed in the end closure, said end closure including a bottom plate and a cylinder extending upwardly from said plate and secured to the lower end of said chamber, a bearing assembly secured to the bottom plate and receiving the end of said rotor, and an upwardly converging conical riser mounted on the bottom plate, said bearing assembly being entirely contained within said conical riser with the upper end of said riser being in proximity to the upper end of the bearing assembly, whereby the bearing assembly is located in proximity to said rotor but away from the processing atmosphere.

2. A thin film thermal processor according to claim 1 wherein, the bearing assembly comprises, a central aperture formed in the bottom plate, a housing positioned within the central aperture and secured to the bottom plate, said housing having an upwardly extending hub portion surrounded by the conical riser, a stub shaft connected to the end of said rotor, said stub shaft extending within the hub and housing, a seal positioned between the hub and the stub shaft, and an anti-friction bearing mounted between the housing and the stub shaft.

3. A thin film thermal processor according to claim 1 wherein a flat annular surface is formed on the bottom plate between the conical riser and the cylinder, said discharge opening being formed by a semi-circular aperture extending across said flat annular surface and intersecting a rectangular aperture formed in the vertical wall of said cylinder, and lower portions of said blades extending in proximity to the flat annular surface, whereby the tips and end portions of said blades pass the area of both said apertures.

4. A processor according to claim 1 including a discharge pipe eccentrically mounted on said end closure and communicating with said discharge opening.

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