United States Patent [19]

Cressman

[11] **3,795,121**

[45] **Mar. 5, 1974**

[54] **HELICAL SHELF FOR ROTARY INCLINED PROCESSING TANK**

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[22] Filed: **Feb. 26, 1973**

[21] Appl. No.: **335,713**

[30] **Foreign Application Priority Data**

Mar. 10, 1972 Canada 136764

[52] **U.S. Cl.** **69/30**

[51] **Int. Cl.** **C14c 15/00**

[58] **Field of Search** 69/30

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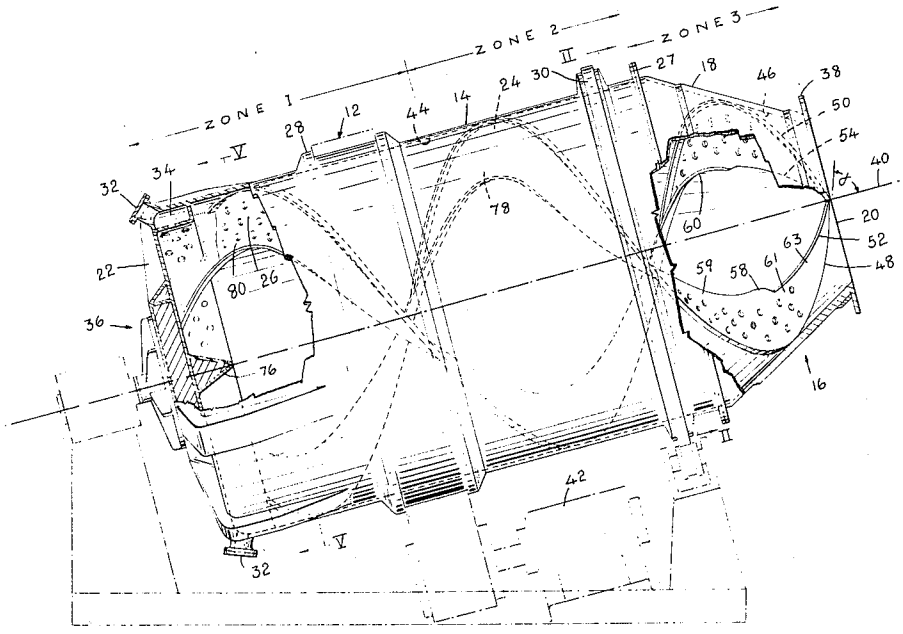
Primary Examiner—Alfred R. Guest

[57] **ABSTRACT**

A pair of helically shaped flat shelves each having a first rearward curving lip along a portion of its inner edge located in a generally cylindrical rotatable processing tank, such as a hide processing tank, with an axis of rotation inclined to the horizontal. Rotation of the tank about the axis of rotation causes the shelves to move thereby producing improved circulation of the hides in suspension in processing fluid in the tank. The circulating motion of the hides is down the walls of the tank along the shelves towards the rear and up the central portion of the tank towards the front. In addition to this improved circulation, the hides are also lifted up the walls by the motion of the shelves and dropped back into the processing fluid, thereby subjecting the hides to improved "scudding" action. This lifting and dropping action is dependent upon lips which curve from the inner edge of the shelves towards the rear of the tank. The degree of lifting action is also determined by the pitch of the shelves as well as the angle of inclination of the axis of rotation, and therefore the pitch of the shelves is varied in three different zones along the length of the tank to produce different lifting action in each zone. The junctions of the shelves with the rear end of the tank are filled to form smooth sloping surfaces and a deflection barrier provided across the rear end of the tank between the junctions to provide improved circulation of the hides in the tank. The shelves may also each have a second forward curving lip extending a second portion of its inner edge through a truncated cone shaped body portion leading to a front opening. Processed hides may be removed from the tank by reversing the direction of rotation of the tank. The hides are retained on the shelves by the second curved lips as they are carried forwardly along the shelves to the front opening.

19 Claims, 8 Drawing Figures



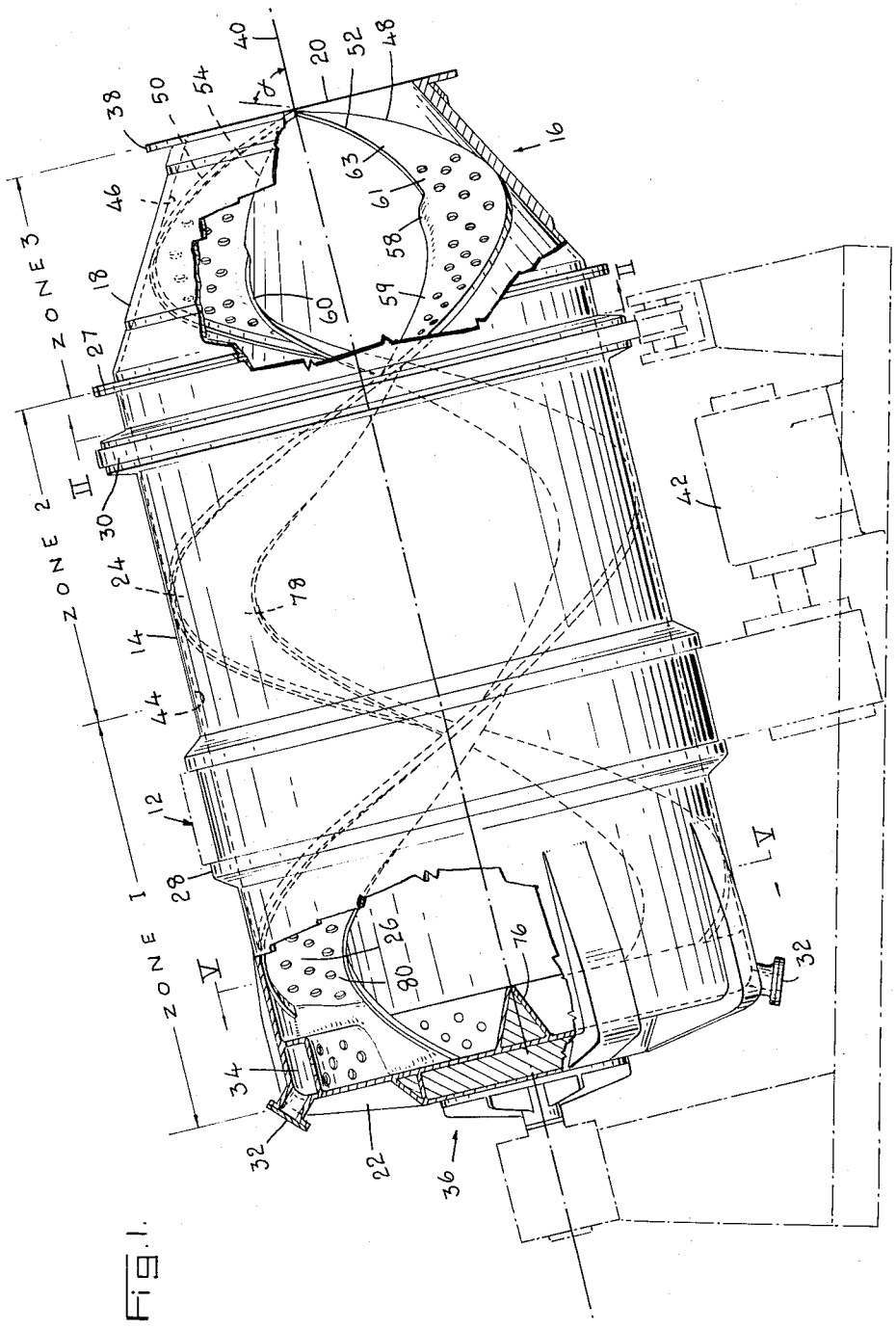

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Fig. 1.

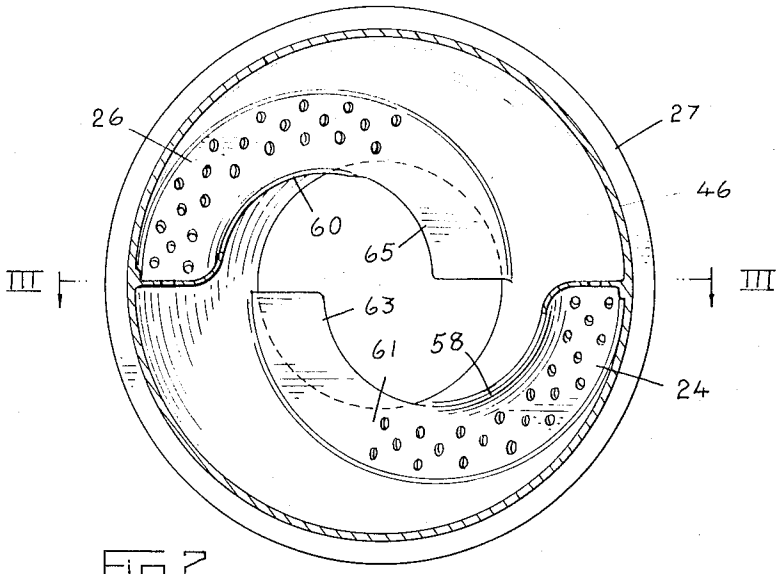


Fig. 2.

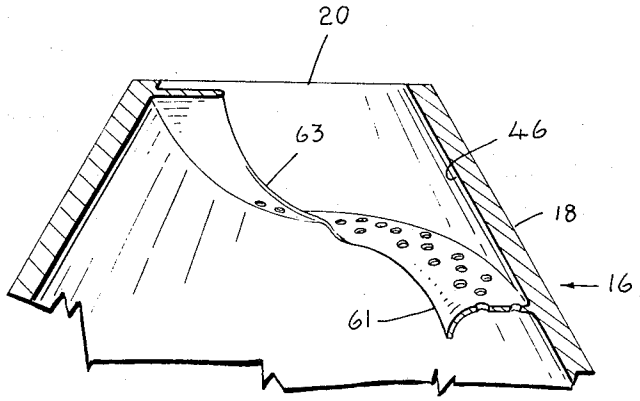


Fig. 3.

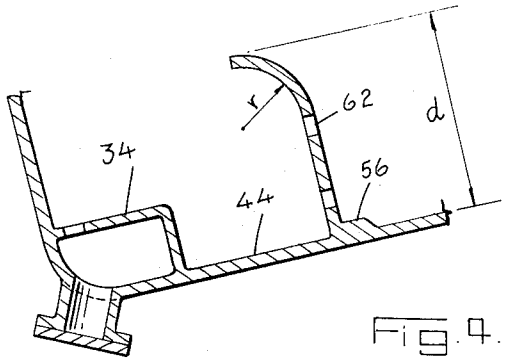
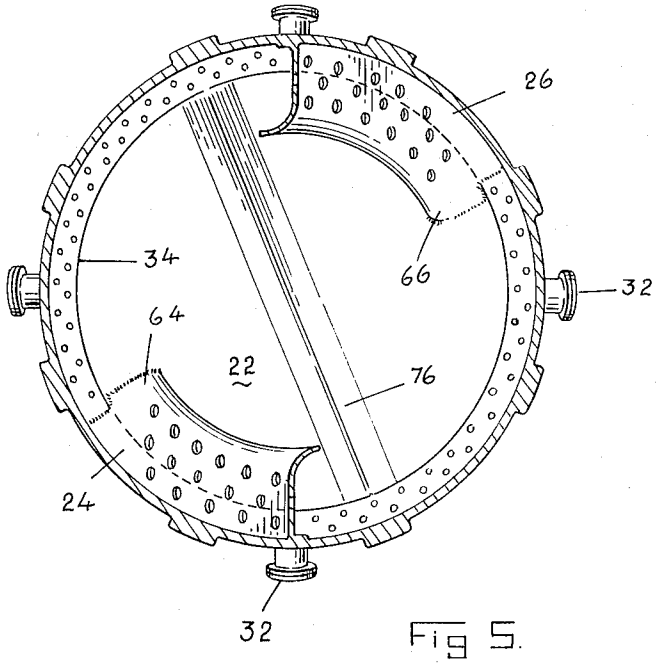


Fig. 4.



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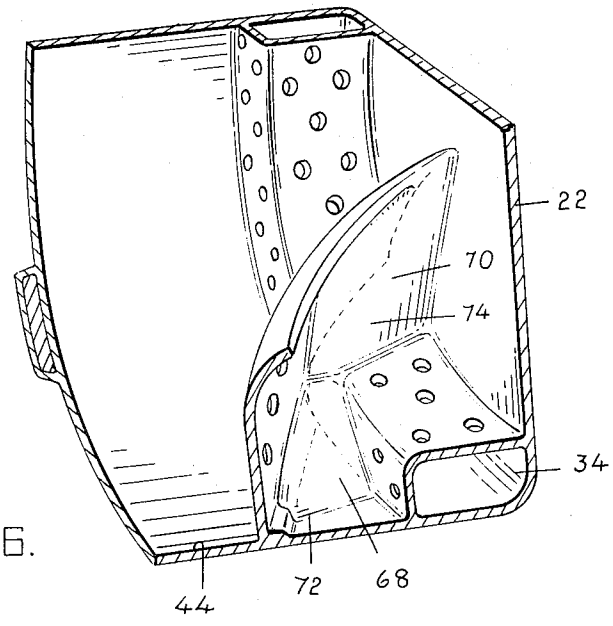

Fig. 6.

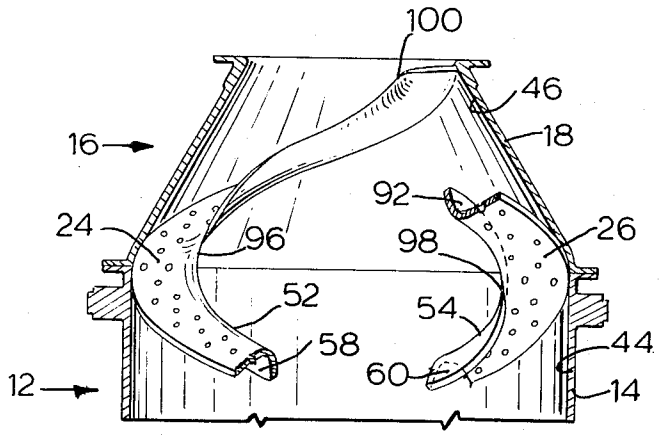

FIG. 7.

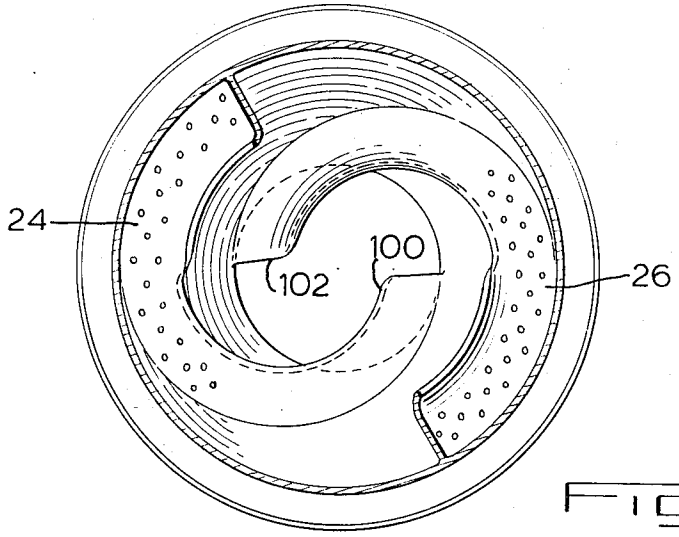

FIG. 8.

HELICAL SHELF FOR ROTARY INCLINED PROCESSING TANK

BACKGROUND OF THE INVENTION

This invention relates generally to processing tanks, and more particularly to helical shelves located in such processing tanks.

The applicant's copending Canadian Application No. 094,622 entitled "Fiberglass Processing Tank" filed Oct. 2, 1970 discloses an inclined processing tank used in the hide processing industry, with which the helical shelves may of the present invention be used. The processing tank disclosed in Application No. 094,622 and in the present disclosure is a rotating, generally cylindrically shaped tank, similar in appearance to the truck mounted concrete mixers in common use. However, it is to be understood that the helical shelves of the present invention are not to be restricted to use in this particular tank, nor to use in the hide processing industry.

In the past in the hide processing industry, a variety of shelves, baffles and fins have been used in hide processing tanks in attempts to provide improved processing of the hides by the processing fluid as the tank is rotated. However, none of these arrangements have provided optimum processing of the hides, and all have had the disadvantage that the hides are not satisfactorily circulated through the processing fluid.

More recently, spiral fins have been used on inclined rotating tanks in an attempt to produce an improved mixing action on the hides in the tank. This arrangement while being an improvement over the previous arrangements, still has the disadvantage that the hides are not satisfactorily circulated through the processing fluid in the tank to result in the desired quality of processing of the hides. Processed hides may be conveniently removed from tanks of this type by reversing the direction of rotation of the tank to carry the hides forwardly along the fins or shelves to a front opening. However, during this process, it has been found that some of the hides carry over the shelves towards the rear of the tank. In addition, it has been found that in some cases involving larger hides, the shelves interfere with the loading of the dry hides into the tank.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to at least partially overcome these disadvantages by providing an improved helical shelf for an inclined rotating processing tank.

To this end, in one of its aspects, the invention provides in a rotatable processing tank of molded fiberglass resin laminate located with its axis of rotation inclined to the horizontal and having a closed lower rear end, a main body portion with a cylindrically shaped wall, and an open upper front end,

a helically shaped shelf extending along at least a portion of the inside surface of the wall of the main body portion, said shelf having an outer and inner edge, the outer edge being rigidly secured to the said cylindrically shaped wall, and a first curved lip extending along at least a first portion of its inner edge said first lip curving toward the rear end of the tank.

In another of its aspects, the invention further provides in a rotatable processing tank of molded fiberglass resin laminate located with its axis of rotation inclined to the horizontal and having a closed lower rear end, a main body portion with a cylindrically shaped wall extending from the rear end, a truncated cone body portion having a cone shaped wall extending from the main body portion, and an open upper front end defined by the cone shaped body portion to be smaller in diameter than the main body portion,

a pair of equally spaced helically shaped shelves, each shelf having an outer and inner edge, each shelf extending from the closed rear end to the open front end of the tank, each shelf being rigidly secured along its outer edge to the cylindrical shaped wall of the main body portion and to the cone shaped wall of the cone shaped body portion, each shelf having a first rearwardly curved lip extending along a first portion of its inner edge and a second forwardly curved lip extending along a second front portion of its inner edge.

Further objects and advantages of the invention will appear from the following description taken together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially cut-away elevation view of a processing tank, showing a pair of helical shelves according to a preferred embodiment of the invention;

FIG. 2 is a sectional view taken along line II—II in FIG. 1;

FIG. 3 is a sectional view taken along line III—III in FIG. 2;

FIG. 4 shows one of the shelves seen in FIG. 1, in transverse section;

FIG. 5 is a sectional view taken along line V—V in FIG. 1;

FIG. 6 is a cut-away perspective view of a junction between one of the shelves and the lower end of the tank seen in FIG. 1;

FIG. 7 is a sectional view similar to FIG. 3, of an alternate embodiment of the invention, and

FIG. 8 is a sectional view similar to FIG. 2, of the embodiment shown in FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference is first made to FIG. 1 which shown a processing tank **10** having a main body portion **12** with a generally cylindrically shaped wall **14**, a truncated cone body portion **16** with a generally cone shaped wall **18**, an open upper front end **20**, a closed lower rear end **22**, and a pair of helically shaped shelves **24, 26.** The truncated cone body portion **16** is attached to extend the main body portion **12** along flanges **27** and extends to define the circular open upper front end **20** which is smaller in diameter than the main body portion **12.**

As are more extensively described in copending application No. 094,622, the processing tank **10** also has a belt track **28,** a supporting ring **30,** a plurality of outlets **32** communicating with perforated wash ring **34,** and a hub **36.** The rear end **22,** main body portion **12** and the cone body portion **18** are formed of molded fiberglass resin laminate in a manner described in copending application No. 094,622. The wash ring **34** is substantially rectangular in cross-section and extends around the inside of the tank adjacent the junction between the wall **14** and the rear end **22.**

The cone body portion **16** has a continuous drip-lip **38** extending around its periphery so that any processing fluid which spills out of the open upper front end **20** of the tank will not run downward past the drip-lip **38** towards the rear end **22** of the tank, and by thereby spread over the outer surface of the tank by the rotary motion of the tank.

The processing tank **10** has a longitudinal axis of rotation **40** which is inclined to the horizontal, and about which the tank is rotated at a desired angular velocity by motor **42** or other suitably attached power source. The tank may of course be constructed to be rotated in either direction about the axis of rotation **40** during processing, but in the embodiment shown in the drawings the helically shaped shelves **24, 26** are located for counter clockwise rotation (as seen from the open upper front end **20**) of the tank **10** about the axis **40.**

In the embodiment of the invention shown, each of the pair of helically shaped shelves **24, 26** extends from the rear end **22** of the tank along the inside surface **44** of the cylindrically shaped wall **14** of the main body portion and the inside surface **46** of the cone shaped wall **18** of the truncated cone body portion **16** to the front end **20.** Each shelf has an outer edge **48, 50** and an inner edge **52, 54.** As best seen in FIG. **4,** each shelf is attached along its outer edge to the inside surface **44** of the cylindrical shaped wall of the main body portion **12** by a resin-bonded fiberglass laminate **56.** The shelves **24, 26** are similarly attached by a resin-bonded fiberglass laminate along their outer edges **48, 50** to the inside surface **46** of the cone shaped wall **18** of the truncated cone portion **16** of the tank. The shelves **24, 26** are located in a position in which, in transverse section, they project inward substantially perpendicular from the cylindrically shaped wall **14.** The shelves **24, 26** each have a first curved lip **58, 60** extending rearward from its inner edge **52, 54.** The first lips extend along a first lipped portion **59** of the inner edge of each shelf from the rear end **22** through the main body portion **12** and part way through the truncated cone body portion **16.** As best seen in FIGS. **2** and **3** the first lip on each shelf terminates part way through the cone body portion **16,** and through the remaining portion of the cone body portion **16** to the front end of the tank, the width of each shelf is extended so that this remaining lipless portion **61** of each shelf projects inwardly from the cone shaped wall **18** the same distance as the combined shelf and first lip of the first mentioned lipped portion of each shelf projects inwardly from the cylindrically shaped wall **14** or the cone shaped wall **18.** Each shelf **24, 26** is perforated with a number of holes **62** along its length except for a non-perforated portion **63, 65** extending from part way through the cone body portion **16** to the front end **20** of the tank.

The shelves **24, 26** and the lips **58, 60** are formed of molded fiberglass resin laminate, and are preferably formed so that the first lips are integral with the shelves along the lipped portion of each shelf.

In the preferred embodiment shown in the drawings, each first lip **58, 60** terminates a distance of approximately 36 inches from the front end **20** of the tank, measured along the respective shelf. The distance, *d* that the lipless portion of the shelf and the combination of the first lip and the lipped portion of the shelf respectively project inwardly from the inside surface **46** of the cone shaped wall and the inside surface **44** of the cylindrically shaped wall is approximately 16 inches. The radius of curvature *r* of the lips **58, 60** is approximately 6 inches. There are three rows of approximately 1 ½ inch diameter perforated holes **62** in each shelf, the rows are 3 inches apart and the holes are 6 inches apart. The perforate holes **62** in each shelf terminate a distance of approximately 18 inches from the front end **20** of the tank measured along the respective shelf. It is, of course, to be understood that these dimensions are given by way of example of the invention, and are not be be taken as a limitation thereof.

In the preferred embodiment shown, the helix angle α between each shelf and the axis of rotation **40** decreases from the front end **20** toward the rear end **22** of the tank. This increase in pitch from the front end to the rear end occurs in three steps or stages corresponding to zone **1,** zone **2** and zone **3** shown in FIG. **1.** In zone **1,** adjacent the rear end **22** of the tank, the pitch of each shelf is such that the shelf would extend through an arc of 180° in approximately three-fifths the length of the tank; in zone **2** each shelf would extend through an arc of 180° in approximately two-fifths the length of the tank; and in zone **3,** adjacent the front end **20** of the tank, each shelf extends through an arc of approximately 180° in the length of the cone body portion. Although in this embodiment, the pitch of the shelves is substantially constant through each zone, it must of course vary slightly towards each side of each zone in order to result in a smooth transition to the next zone. It is similarly to be understood that these pitch dimensions are given by way of example and are not to be taken as a limitation of the invention.

FIG. **6** shows one of the junctions **64, 66** between the shelves **24, 26** and the rear end **22** of the tank. As may be seen the wash ring **34** extends through the shelf at this point to form recesses **68, 70** between the inside surface **44** of the cylindrically shaped wall, the wash ring **34,** the rear end **22,** and the shelf. In practice, it has been found advantageous to fill these recesses **68, 70** with resin bonded fiberglass to provide sloping surfaces **72, 74** of the respective junction.

As shown in FIGS. **1** and **5,** a V-shaped deflection barrier **76** extends across the rear end **22.** The barrier **76** is formed of a fiberglass resin laminate and is resin-bonded to the rear end **22** and the inside surface **44** of the cylindrical shaped wall. In the embodiment shown, the barrier **76** extends in a direction approximately perpendicular to an imaginary line joining the junctions **64, 68** of the shelves **24, 26** with the rear end **22.** Although the tank shown has a pair of helically shaped shelves **24, 26** it is possible that a tank having only a single similar shelf could be used.

In use in the hide processing industry, the processing tank **10** is partially filled with hides in suspension in a hide processing fluid, and the tank is rotated counter clockwise (as viewed from the front end **20**). In order to obtain optimum results, it is desirable to exert an improved "scudding" action on the hides. This desired "scudding" action involves producing numerous two directional bends over the entire area of each hide to pop out the bulbs which hold the hairs in place. In order to obtain improved "scudding" action it is necessary that the hides continuously circulate in the tank without stopping in dead spots and that the circulatory motion of the hides is such as to result in improved two directional bending of the hides. It has been found that the helically shaped shelves according to the invention

produce this desired action by slowly moving the hides towards the rear of the tank to maintain circulation, while at the same time lifting the hides up the inside surface of the cylindrically shaped wall **44** and dropping them to produce the bending action. As the tank **10** rotates, the shelves **24, 26** move through the processing fluid and the leading faces **78, 80** of the shelves come in contact with some of the hides in suspension in the fluid. The motion of the shelves causes some of the hides contacted by the leading faces **78, 80** to be lifted up the inside surface of the wall and moved towards the rear end **22** of the tank. When the hides which are moved towards the rear end **22** of the tank reach the sloping surfaces **72, 74** of the respective junctions **64, 68,** they are discharged back into free suspension in the porcessing fluid in the central portion of the tank and are carried towards the front end **20** of the tank by circulation of the processing fluid through the central portion of the tank. Filling of the recesses **68, 70** with resin bonded fiberglass to provide sloping surfaces **72, 74** has been found to improve circulation of the hides in the tank as it quickens discharge of the hides from the shelves and avoids the hides being retained in the recesses. The sloping surfaces **72, 74** also reduces the backwash of the processing fluid from each junction **64, 66** across the tank which hinders discharge of the hides from the opposite junction. Similarly, it has been found that use of the deflection barrier **76** divides the flow of the processing fluid from the junctions to reduce the effect of this backwash on the discharge of hides from the opposing junctions and, therefore improves circulation of the hides towards the front of the tank through the central portion of the tank. As a result, it has been found that "dead spots" or pockets of hides which are not circulating have been eliminated. The hides which are lifted by the shelves **24, 26,** mount the inside surface of the walls **44** to varying positions before dropping back into the processing fluid in the central portion of the tank. This improved lifting action, which results in some of the hides being carried up the wall **44** by the shelves **24, 26** to positions near the top of the tank, is permitted by the existence and shape of the lips **58, 60** on the shelves. The degree of lifting or mounting action is also dependent of the inclination of the axis of rotation **40** and the pitch or helix angle α of the shelves.

Therefore, the combination of longitudinal circulatory motion and lifting action of the hides varies somewhat in the different zones. In rear zone **1,** in which the helix angle α of the shelves is the least, the dominant action is that of lifting and dropping of the hides although, as mentioned above, a gentle action due to the pitch of the shelves forces the hides along the shelves toward the rear end of the tank. In zone **2,** a slightly less vigorous lifting action is found, with a greater force producing a longitudinal movement towards the rear of the vessel. This longitudinal movement aids in the shifting of the suspended hides through zone **1.** In zone **3,** the volume of hides being processed is considerably less due to the smaller capacity in this area. The helix angle α is a maximum so that the dominant action becomes the rearward longitudinal force with just a slight lifting action. The increases helix angle α in zone **3** also helps to prevent hides being forced out the open front end **20** of the tank by the circulation of processing fluid through the central portion of the tank towards the front end. The movement of the shelves with the greater helix angle through the processing fluid as the tank rotates combined with the smaller capacity of zone **3,** reverses the direction of the processing fluid and starts it moving along the shelves towards the rear end of the tank.

In summary, the combined lateral and lifting circulation pattern of the hides in the processing fluid depends upon a variety of factors, such as the number, size, shape and pitch of the shelves, the shape of the junctions between the shelves and the rear end of the tank, the shape and position of the deflection barrier, the angle of inclination and the speed of rotation of the tank, the type of hides, and the density and viscosity of the processing fluid. The holes **62** in the shelves have also been found to improve mixing of the processing fluid by releasing the hydraulic pressure built up against the shelves as they move through the fluid.

At the end of the processing cycle, the processing fluid may be removed from the tank through the outlets **32,** and the hides may be removed by reversing the direction of rotation of the tank. This results in the hides being carried to the front end **20** of the tank by the shelves. An advantage of the shelves having the greatest helix angle α through zone **3** is that the maximum lift of the hides toward the open front end **20** is provided where it is necessary through the cone body portion **16** of the tank. The holes **62** in the shelves are again of use, in that they allow the residual processing fluid to flow toward the rear end of the tank while the hides are carried to the front end.

Reference is now made to a second embodiment of the invention, as shown in FIGS. **7** and **8,** which provides a second curved lip which extends along a front portion of the inner edge of each shelf and curves towards the front of the tank rather than towards the rear. This allows the shelves to be formed of a lesser width near the front of the tank for those applications where this is a problem in loading dry hides into the tank.

The pair of helically shaped shelves **24, 26** are shown extending along the inside surface **44** of the cylindrically shaped wall **14** of the main body portion **12** and the inside surface **46** of the cone shaped wall **18** of the truncated cone body portion **16.** As may be seen, each of the shelves has a second curved lip **90, 92** extending along a second portion **94** of the inner edge **52, 54** of each shelf. Each of the second curved lips **90, 92** extends towards the front end **20** of the tank, and each of the shelves also has a gradually curved transition lip portion **96, 98** which connects the first and second curved lips. As seen in this embodiment, the transition lip portions are located adjacent the junction between the main body portion **12** and the truncated cone body portion **16.** Therefore, the rearwardly extending first curved lips **58, 60** are substantially located within the main body portion **12,** while the forwardly extending second curved lips **90, 92** are substantially located in the truncated cone body portion **16.** The structure of the second curved lips **90, 92** is otherwise substantially the same as that of the first curved lips **58, 60,** except that the combined width of the shelf and second lip is somewhat less. By way of example, the combined width of the shelf and first lip shown is 16 inches, while the combined width of the shelf and second lip is 14 inches. The front corners **100, 102** of the second curved lips are tapered to avoid extension beyond the front end **20**

and to provide a greater effective opening distance between them.

In use, the processed hides are removed from this second embodiment of the tank through the open front end **20** by reversing the direction of rotation of the tank. The hides are retained on the shelves **24, 26** by the second curved lips **90, 92** as they are carried forwardly along the shelves through the truncated cone body portion **16** of the tank.

Although the disclosure describes and illustrates preferred embodiments of the invention, it is to be understood that the invention is not restricted to these particular embodiments.

What I claim is:

1. In a rotatable processing tank of molded fiberglass resin laminate located with its axis of rotation inclined to the horizontal and having a closed lower rear end, a main body portion with a cylindrically shaped wall, and an open upper front end,

a helically shaped shelf extending along at least a portion of the inside surface of the wall of the main body portion, said shelf having an outer and inner edge, the outer edge being rigidly secured to the said cylindrically shaped wall, and a first curved lip extending along at least a first portion of its inner edge, said first lip curving towards the rear end of the tank.

2. In a processing tank according to claim **1,** a further identical shelf rigidly secured to the said wall to provide a pair of helically shaped shelves equally spaced around the inside surface of the wall of the main body portion, each shelf extending from the closed rear end to the open front end of the tank, each shelf being rigidly secured along its outer edge to the cylindrically shaped wall of the main body portion.

3. In a processing tank according to claim **1,** a second curved lip extending along a second front portion of the inner edge of the helically shaped shelf, said second lip curving towards the front end of the tank, said shelf having a gradually curved transition lip portion connecting the first curved lip to the second curved lip.

4. In a processing tank according to claim **3,** a further identical shelf rigidly secured to said wall to provide a pair of helically shaped shelves euqally spaced around the inside surface of the wall of the main body portion, each shelf extending from the closed rear end to the open front end of the tank, each shelf being rigidly secured along its outer edge to the cylindrically shaped wall of the main body portion.

5. In a rotatable processing tank of molded fiberglass resin laminate located with its axis of rotation inclined to the horizontal and having a closed lower rear end, a main body portion with a cylindrically shaped wall extending from the rear end, a truncated cone body portion having a cone shaped wall extending from the main body portion, and an open upper front end defined by the cone shaped body portion to be smaller in diameter than the main body portion,

a pair of helically shaped shelves equally spaced around and extending along at least a portion of the inside surface of the wall of the main body portion, each shelf having an outer and inner edge, the outer edge being rigidly secured to the said cylindrically shaped wall, and a first curved lip extending along at least a first portion of its inner edge, each said first lip curving towards the rear end of the tank.

6. A pair of helically shaped shelves as claimed in claim **5,** each shelf extending from the closed rear end to the open front end of the tank, each shelf being rigidly secured along its outer edge to the cylindrically shaped wall of the main body portion and to the cone shaped wall of the cone shaped body portion.

7. A pair of helically shaped shelves as claimed in claim **5,** each shelf extending from the closed rear end to the open front end of the tank, each shelf being formed of molded fiberglass resin laminate and bonded along its outer edge to the cylindrically shaped wall of the main body portion and to the cone shaped wall of the cone shaped body portion by a resin-bonded fiberglass laminate, each shelf projecting inward, in transverse section, substantially perpendicular to the cylindrical wall of the main body portion of the tank, each shelf forming a junction with the closed rear end of the tank, each junction being filled to provide relatively smooth sloping surfaces between the respective shelf, the lower end of the tank and the wall of the main body portion.

8. A pair of helically shaped shelves as claimed in claim **6,** each shelf extending to form a junction with the closed rear end of the tank, the tank also having a deflection barrier projecting inward from the rear end of the tank to bisect the rear end substantially perpendicular to an imaginary straight line extending between the said two junctions, the deflection barrier having a cross-section in the shape of an inverted V.

9. A pair of helically shaped shelves as claimed in claim **6** each shelf having a helix angle with respect to the longitudinal axis of the tank which increases in steps towards the front end of the drum.

10. A pair of helically shaped shelves as claimed in claim **6** the tank also having a continuous perforated wash ring located adjacent the wall and the rear end of the tank, the wash ring being substantially rectangular in cross-section.

11. A pair of helically shaped shelves as claimed in claim **6,** each shelf having a second curved lip extending along a second front portion of its inner edge, each said second curved lip curving towards the front end of the tank, each shelf having a gradually curved transition lip portion connecting the first curved lip to the second curved lip.

12. A pair of helically shaped shelves as claimed in claim **11** wherein each transition lip portion is located substantially adjacent the junction between the main body portion and the truncated cone body portion.

13. A pair of helically shaped shelves as claimed in claim **11** wherein the first lip projects inwardly from the outer edge of the shelf a greater distance than the second lip.

14. A pair of helically shaped shelves as claimed in claim **11** each shelf extending to form a junction with the closed rear end of the tank, the tank also having a deflection barrier projecting inwardly from the rear end of the tank.

15. A pair of helically shaped shelves as claimed in claim **11,** each shelf extending to form a junction with the closed rear end of the tank, the tank also having a deflection barrier projecting inward from the rear end of the tank to bisect the rear end substantially perpendicular to an imaginary straight line extending between the said two junctions, the deflection barrier having a cross-section in the shape of an inverted V.

16. A pair of helically shaped shelves as claimed in claim 11 each shelf being formed of molded fiberglass resin laminate and bonded to the cylindrically shaped wall of the main body portion by a resin-bonded fiberglass laminate, each shelf forming a junction with the closed rear end of the tank, each junction being filled to provide relatively smooth sloping surfaces between the respective shelf, the lower end of the tank and the wall of the main body portion.

17. A pair of helically shaped shelves as claimed in claim 11, each shelf having a helix angle with respect to the longitudinal axis of the tank which increases in steps towards the front end of the drum.

18. A pair of helically shaped shelves as claimed in claim 11 each shelf having a helix angle with respect to the longitudinal axis of the tank which increases in first, second and third steps towards the front end of the drum, first, second and third steps corresponding to first, second and third zones of the tank, the first zone being adjacent the rear end of the tank and the third zone corresponding to the cone body portion of the tank.

19. A pair of helically shaped shelves as claimed in claim 11, the tank also having a continuous perforated wash ring located adjacent the wall and the rear end of the tank, the wash ring being substantially rectangular in cross-section.

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