May 12, 1959 G. OVERTON 2,886,101

APRON FOR DRUM DRIERS

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Fig. 1

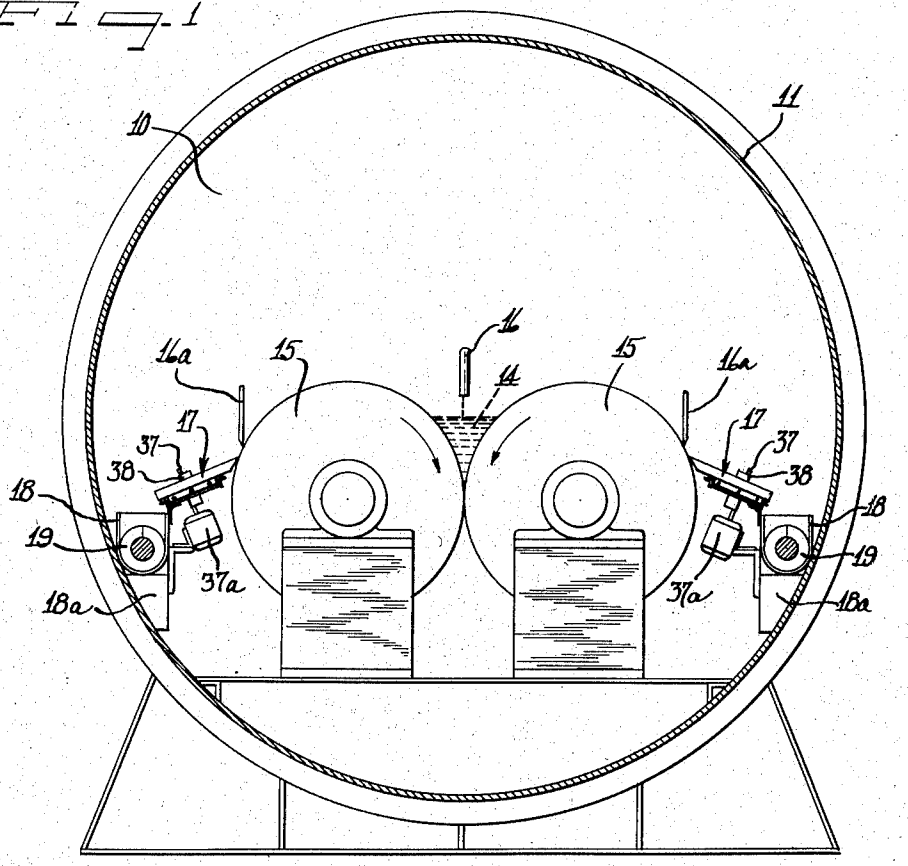


Fig. 6

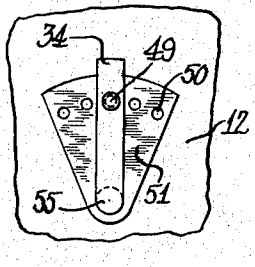


Fig. 3

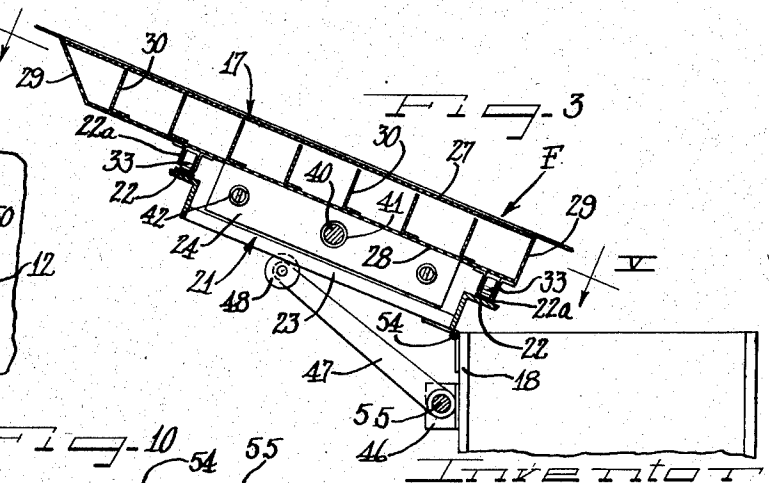
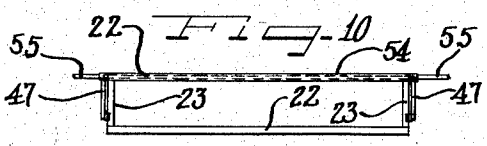


Fig. 10



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Fig. 2

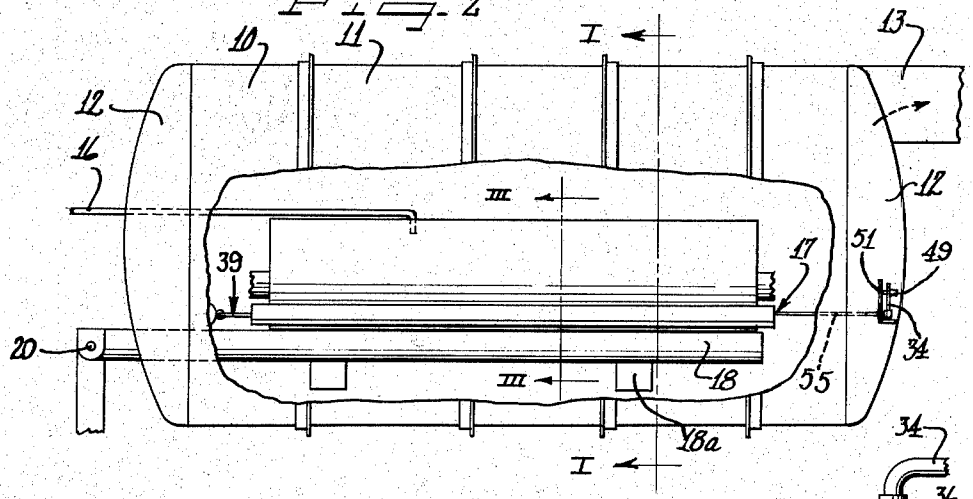


Fig. 4

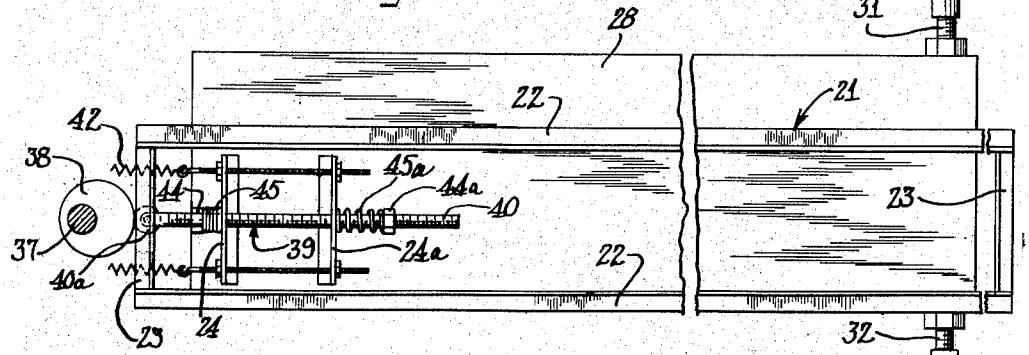
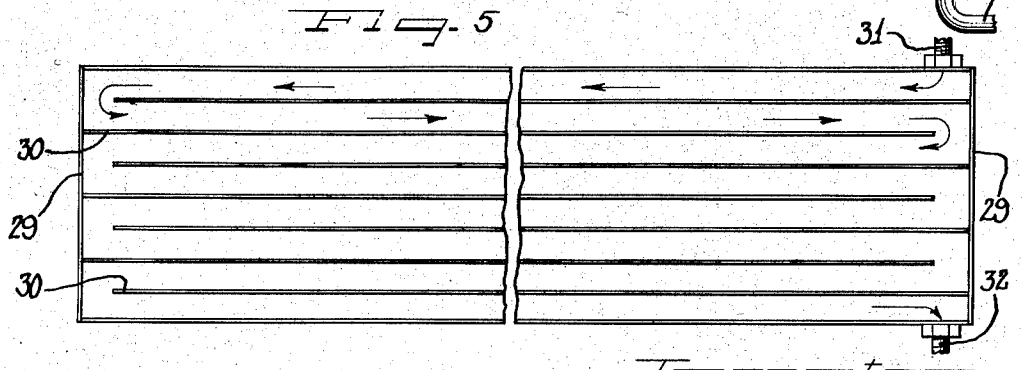


Fig. 5



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APRON FOR DRUM DRIERS

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Fig. 7

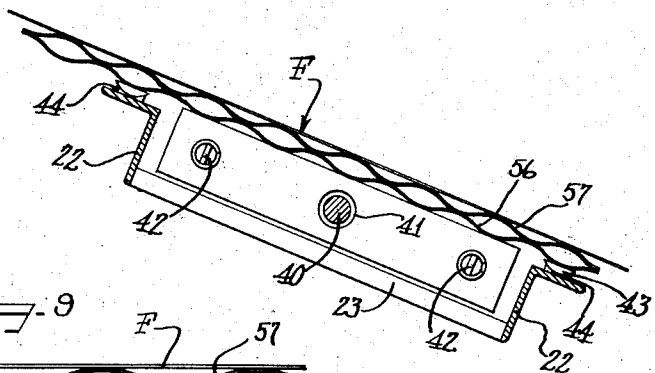


Fig. 9

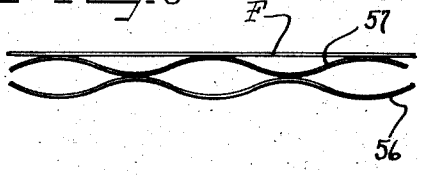
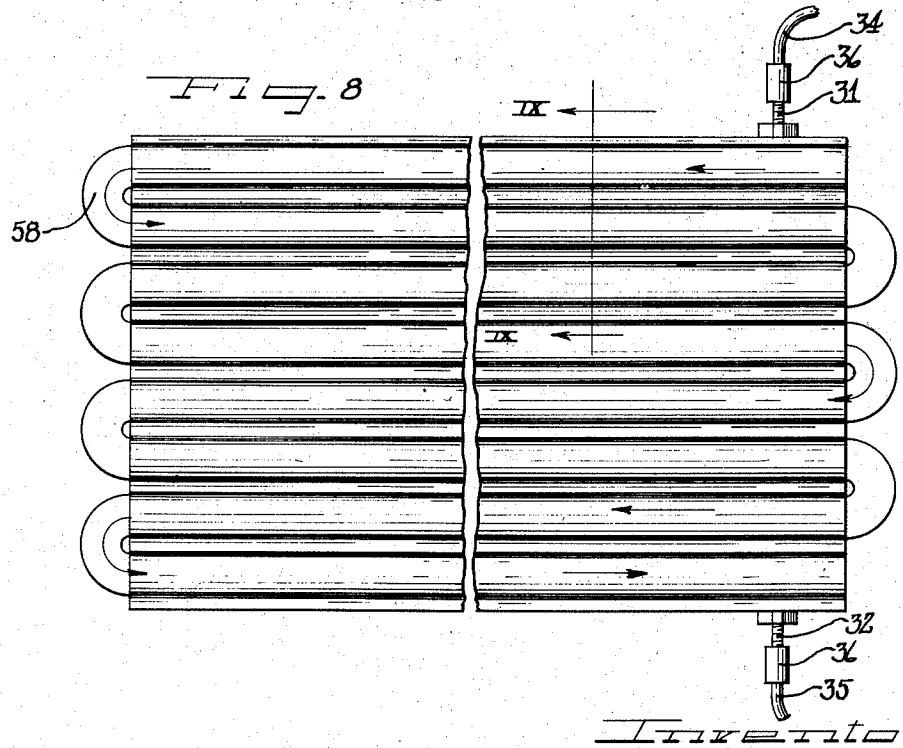


Fig. 8



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2,886,101

APRON FOR DRUM DRIERS

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Application December 31, 1952, Serial No. 328,865

8 Claims. (Cl. 159—11)

This invention relates generally to a conveying apron apparatus attachable to or mounted in a vacuum-type drum drying machine, and more particularly to a water cooled-type apparatus incorporating features of material advantage in receiving dried material discharged from a heated drying drum.

Drum drying machines comprise generally a rotary drying element such as a heated drum, having a portion of its peripheral surface communicating with a trough containing material to be dehydrated or dried, a scraper element to remove the coating of material formed during the drying process and adhering to the outer cylindrical surface of the drum, and a material handling device, such as an inclined apron, to deflect the dry product as it is removed from the cylinder by the scraper blade into a conveyor or receptacle of some kind. In this operation, there is a tendency for the dried film to be overheated and cooked due to the residual heat in the material after the drying operation has been completed. It has been found that this residual heat continues to cook the material after the dehydration process has been completed with the result that caramelizing sets in and the material is rendered useless.

To the end that the above indicated difficulty may be avoided, and as an important object of the invention, there is provided an improved water cooled conveying apron to overcome this objectionable action wherein the dehydrated film is effectively cooled immediately upon its removal from the hot dehydrating drum. With this end in view, it is possible for a dehydrated film of material to be deprived of its residual heat and thereby afford easy removal from the drying drum, and at the same time facilitate the progression of the dried film.

Accordingly, the present invention is directed toward and has as an object the provision of a water cooled type drum drier apron combination incorporating improved features of construction affording means to remove residual heat from and to deflect the dry product as it is removed from the drum drier into a conveyor or receptacle of some kind.

Another object of the present invention is to provide a water-cooled-type implement attachment including parts constructed and combined for coaction with each other in an improved manner for imparting a simple reciprocating drive motion thereto, and for eliminating the provision of separate means for preventing the adherence of dry material to the conveying apron.

Still another object of this invention is to provide an improved form of conveying apron such as a crimped or corrugated apron for conveying dry material to a receptacle with a minimum of surface contact whereas in some instances, for example, the dried material has gummy or sticky characteristics.

A further object of the invention is to provide a movable apron supporting frame arranged to extend parallel to and adjacent the drying drum to accommodate relative movement of the apron with respect to the drying drum.

With these and other objects in view, it will become clear from the detailed description to follow, the invention contemplates the provision of a water-cooled-type conveying apron for use in conjunction with either a single or double cylinder film drying equipment.

On the drawings:

Figure 1 is a transverse cross-sectional view with parts in end elevation of the apparatus taken along the line I—I of Figure 2;

Figure 2 is a side elevational view of the apparatus with parts broken away to show underlying parts;

Figure 3 is an enlarged sectional view of the conveying apron and mounting assembly therefor, taken along the line III—III of Figure 2;

Figure 4 is a bottom plan view of the conveying apron assembly of Figure 3 showing the drive mechanism;

Figure 5 is a horizontal sectional view of the conveying apron taken along the line V—V of Figure 3 and showing details of the baffle-type cooling system;

Figure 6 is an enlarged end elevational view of a fragmentary part of the apparatus of Figure 2 showing details of the apron adjusting mechanism;

Figure 7 is an enlarged sectional view of a modified form of water-cooled apron which may be used in the apparatus of Figure 1;

Figure 8 is a horizontal sectional view of the modified apron shown in Figure 7;

Figure 9 is an enlarged sectional view of the modified apron, taking along the line IX—IX of Figure 8; and

Figure 10 is a diagrammatic sketch showing further details of the apron adjusting mechanics.

As shown on the drawings:

In Figures 1 and 2 numeral **10** designates a vacuum-type housing or receptacle equipped in accordance with this invention. Receptacle **10** which is gas-tight consists of a cylindrical body **11**, end heads or plates **12**, and a vacuum exhaust outlet opening **13**, adapted to be connected to a vacuum pump (not shown) for evacuating air from the receptacle tank.

Referring particularly to Figure 1, numeral **15** designates cylindrical drier drums which may be rotated by a power unit not shown in the drawings. The drums **15** cooperate to define a nip trough **14** therebeteween and are internally heated by steam. Numeral **16** designates the inlet or feed pipe to the nip trough between the drums, for feed of liquid or slurry to be dried such as milk, distilling waste slurry, food slurries and the like.

In Figure 1, the illustrated left-hand drum **15** rotates clockwise and the right-hand drum **15** rotates counterclockwise to collect liquid from the nip trough and maintain a film thereon which has a thickness gauged by the nip between the rolls. The films of material on the surfaces of these drums are dried and scraped off of the drums by scraper blades **16*a***, commonly referred to as doctor blades. The dried films from the scraper or doctor blades are deposited on inclined plate aprons **17** of this invention. The aprons **17** support and guide the films such as F (Figure 3) to troughs **18** carried by brackets **18*a*** and equipped with screw conveyors **19**. The conveyors **19** break the films into flakes or powder form and move the material to discharge outlet **20** at the front end of the housing.

The conveying apron **17** consists of a hollow cooling box or tray formed of sheet metal or other good heat transfer and rigid material. The box or tray has a bottom wall **28**, end and side walls **29**, and an apron plate cover **27** supported by and secured to the top edges of the side and end walls to form a sealing fit therewith in the manner illustrated in Figure 3. Within the cooling box formed by the bottom wall **28** and the end and side walls **29** are a series of baffle plate **30** secured to the bottom **28** and tightly abutting the top wall or cover plate **27**, each baffle

plate being of a length shorter than the length of the cooling box and each having one end thereof secured alternatingly to opposite end walls **29** to form the baffle plates in parallel and staggered relation, as clearly indicated in Figure 5, whereby liquid coolant such as water entering inlet pipe **31** is forced to follow a winding serpentine path before it leaves outlet pipe **32**. It is to be understood that whereas in the embodiment illustrated the cooling water is shown as flowing in one direction, the conveying apron is equally adapted to perform its cooling function with a reverse flow of cooling water.

The apron box or tray carries rollers **33** on the bottom thereof which ride on a supporting frame **21**. The supporting frame is of rectangular form consisting of cross bars **23** rigidly connected to angle beams **22**. These angle beams fixedly carry U-tracks **22***a* within which rollers **33** are adapted to roll. In this way the apron may travel back and forth on rollers supported by the frame **21**.

Each supporting frame **21** is hingedly secured along its lower edge to the adjacent wall of trough **18** at **54** and may be swung away from drum **15** by manipulation of a control handle or lever **34** (Fig. 2) next to be described. Handle **34**, which is mounted externally and which is accessible from the outside of the sealed chamber, is formed integral with a rock shaft **55**. This rock shaft, which is journalled in support brackets **46** secured to the wall of trough **18**, has secured or welded along the lengths thereof spaced bell crank arms or lifting fingers **47** equipped with rollers **48** contacting the underside of cross bars **23**. Swinging of handle **34** about rock shaft **55** as a pivot rotates bell crank arm **47** so as to either pivotally raise or lower the supporting frame **21** about its hinge axis **54**. The supporting frame is held in adjusted position by means of a pin **49** fitting in an aperture at the end of handle **34** and in a selected one of the apertures **50** in sector plate **51**, which sector plate is secured to the outside of end plate **12**. The particular angular adjustment of the apron carriage which may be required or desired is dependent on the specific material or slurry being dried and varies for different products. It has been found that in general, a flat angle is the best angle of application for slow but steady delivery of dried material.

The conveying apron is reciprocatingly driven by means of an electric motor **37***a*, whose constantly rotating drive shaft **37** has eccentrically mounted thereon a cam **38** for moving a roller follower arm **39** in a linear direction parallel to the axis of the drier drum. The roller follower arm has a threaded arm **40**, a cam roller **40***a* mounted at one end of the arm, stop nuts **44** and **44***a*, and contact springs **45** and **45***a*. The arm **40** is freely slidable on suitable support structure such as through aligned openings **41** in cross plates **24** and **24***a*, so that spring **45** can act against the cross plate **24** of the apron to move the apron in one direction, and spring **45***a* can act against plate **24***a* to move the apron in the other direction. Either the support structure or plates **24** and **24***a* may be generally identified herein as support plate structure. A pair of springs **42**, each having one end rigidly secured to the body **11** or end wall **12** and having its other end connected to the cross plates, urge the apron in the direction of the drive shaft **37** and insure constant contact between the cam and cam roller.

In this manner the eccentrically mounted rotating cam imparts to the apron carriage a reciprocating agitating motion, similar to the sifting motion commonly associated with a sieve, and the distance through which the apron carriage reciprocatingly moves is controlled by lock nuts **44** and **44***a*.

The eccentrically mounted cam **38** is of cylindrical form, and of sufficient length so that in all positions of the rockable apron about its hinge axis, the cam follower roller **40***a* will be in contact with cam **38**, thus, preventing the apron from riding over the cam when the apron is swung upwardly away from the drum.

In order to allow for agitation of the water-cooled conveying apron, and at the same time provide cooling water therefor, the inlet and outlet cooling water tubes **34** and **35**, respectively, are connected to their associated inlet and outlet pipes **31** and **32** by means of flexible couplings **36**, such as, for example, soft rubber tubing or hose.

From the above description it may be seen that this invention provides a continuous flow of cooling water to a conveying apron which is in constant agitation by reason of the operation of the drive arrangement described hereinabove. This machine is particularly useful in drying material without burning the material or imparting a boiled or cooked flavor thereto.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention. For example, in the modified form of apron carriage illustrated in Figures 7, 8 and 9, the cooling water apron box may be constituted of a pair of crimped or corrugated sheets of sheet metal, **56** and **57**, in opposed relation and secured together to form a series of parallel conduits each connected to one another at the ends by U-type pipe bends **58**, in the manner shown in Figure 8 to form a winding path for cooling water to follow without departing from the spirit or scope of the instant invention.

In the modified form of invention illustrated in Figures 7, 8 and 9, the upper apron sheet **57**, presents a minimum of surface contacts to the film of dried material, and hence is particularly useful where the dried material has gummy or sticky characteristics. Also, in the modified version the apron rollers **33** may be dispensed with, and round head cap screws **43** provided in lieu thereof, whereby, through the action of cam **38** and springs **42** on cross plates **24** and **24***a* the apron may slide along tracks or guides **44** welded to beam **22** in the identical manner that the preferred form of water cooled apron is reciprocatingly rolled therealong.

From the above description it will therefore be understood that cooled reciprocating aprons are provided for drum driers to prevent overheating of dried films while directing these films from the drums to a discharge mechanism.

I claim as my invention:

1. In a vacuum drum drying apparatus having a rotatable drier drum, the improvements which comprise a rockably mounted conveying apron for disposition in proximity to the cylindrical surface of the drum extending along the length of the drum and having a pivotal axis by means of which the angle of inclination of the apron may be adjusted to vary the rate of flow thereover, means for adjustably swinging said apron, means for cooling said apron, a pair of cross plates connected to the underside of the apron, said cross plates having aligned openings for freely receiving the arm of a roller follower arm, an eccentrically driven cam for actuating said roller follower arm in one direction, means urging said roller follower arm in the opposite direction, a pair of stop nuts threaded on said arm, and spring means disposed between said stop nuts for assisting in the reciprocation of the apron, said cross plates being disposed between said stop nuts whereby upon actuation of said roller follower arm in one direction, one of said stop nuts will cooperate with said spring means and urge the apron in said one direction, and upon actuation in the reverse direction, the other of said stop nuts will cooperate with said spring means and impart reverse motion to said apron.

2. In a vacuum drum drying apparatus having a rotatable drier drum, the improvements which comprise a rockably mounted conveying apron for disposition in proximity to the cylindrical surface of the drum extending along the length of the drum and having a pivotal axis by means of which the angle of inclination of the apron may be adjusted to vary the rate of flow thereover,

means for adjustably swinging said apron, means for cooling said apron, said last mentioned means comprising a box of labyrinth construction disposed below said apron, said box having on opposite sides thereof a water inlet and water outlet opening, whereby said labyrinth construction effectively baffles said cooling water along a snake-like path, flexible water hose connections adjacent said openings to permit agitation of said apron, means for agitating said apron including a plurality of cross plates connected to the underside of the apron, said cross plates having aligned openings for freely receiving the arm of a roller follower arm, an eccentrically driven cam for actuating said roller follower arm in one direction, means urging said roller follower arm in the opposite direction, a pair of stop nuts threaded on said arm, and spring means disposed between said stop nuts for assisting in the reciprocation of the apron, said cross plate being disposed between said stop nuts, whereby upon actuation of said roller follower arm by said cam in one direction, one of said stop nuts will urge the apron in one direction and upon actuation in the reverse direction the other of said stop nuts will impart reverse motion to the apron.

3. In a vacuum drum drying apparatus having a rotatable drier drum, the improvements which comprise a rockably mounted conveying apron for disposition in proximity to the cylindrical surface of the drum extending along the length of the drum and having a pivotal axis by means of which the angle of inclination of the apron may be adjusted to vary the rate of flow thereover, means for adjustably swinging said apron, means for cooling said apron, said last mentioned means comprising a container of labyrinth construction disposed below said apron, said container having a water inlet and water outlet opening, whereby said labyrinth construction effectively baffles said cooling water along a snake-like path, flexible water hose connections adjacent said openings to permit agitation of said apron, means for agitating said apron including a pair of cross plates connected to the underside of the apron, said cross plates having aligned openings for freely receiving the arm of a roller follower arm, an eccentrically driven cam for actuating said roller follower arm in one direction, means urging said roller follower arm in the opposite direction, a pair of stop nuts threaded on said arm, and spring means disposed between said stop nuts for assisting in the reciprocation of the apron, said cross plates being disposed between said stop nuts, whereby upon actuation of said roller follower arm by said cam in one direction, one of said stop nuts will urge the apron in one direction and upon actuation in the reverse direction the other of said stop nuts will impart reverse motion to the apron.

4. In a vacuum drum drying apparatus having a rotatable drier drum, the improvements which comprise a conveying apron for disposition in proximity to the drum, means for agitating the apron including a pair of spaced extensions, said extensions having aligned openings for freely receiving the arm of a roller follower arm, an eccentrically driven cam for actuating said roller follower arm in one direction, means urging said roller follower arm in the opposite direction, a pair of stop nuts threaded on said arm, and spring means cooperable with said stop nuts for assisting in the reciprocation of the apron, said extensions being disposed between said stop nuts whereby upon actuation of said roller follower arm in one direction, one of said stop nuts will urge the apron in one direction, and upon actuation in the reverse direction, the other of said stop nuts will impart reverse motion to said apron.

5. The apparatus of claim 4 further characterized by the apron including a corrugated sheet providing a surface adapted to receive dried film material thereover, and means for cooling said sheet.

6. The apparatus of claim 4 further characterized by a pair of corrugated sheets secured together for defining a plurality of passages therebetween, and means for flowing liquid coolant through said passages.

7. In a drum drying apparatus, a rotatable drier drum carried on the apparatus, a conveying apron connected to the apparatus for disposition in proximity to the drum, actuating means reciprocating the apron axially of the drum including support plate structure, said actuating means including a roller follower arm connected to the plate structure, and said actuating means including means for actuating said roller follower arm back and forth, said actuating means also including stops on opposite sides of said support plate structure whereby upon actuation of said roller follower arm in one direction, one of said stops will cooperate with the actuating means and urge the apron in one direction, and upon actuation in the reverse direction, the other of said stops will cooperate with the actuating means and will impart reverse motion to said apron.

8. The drum drying apparatus of claim 7 further characterized by means for water cooling the apron, said last mentioned means comprising a water sealed box labyrinth construction having a water inlet and a water outlet opening, and providing a snake-like path for cooling between the inlet and the outlet, and flexible water hose connections adjacent said openings to permit reciprocation of said apron.

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