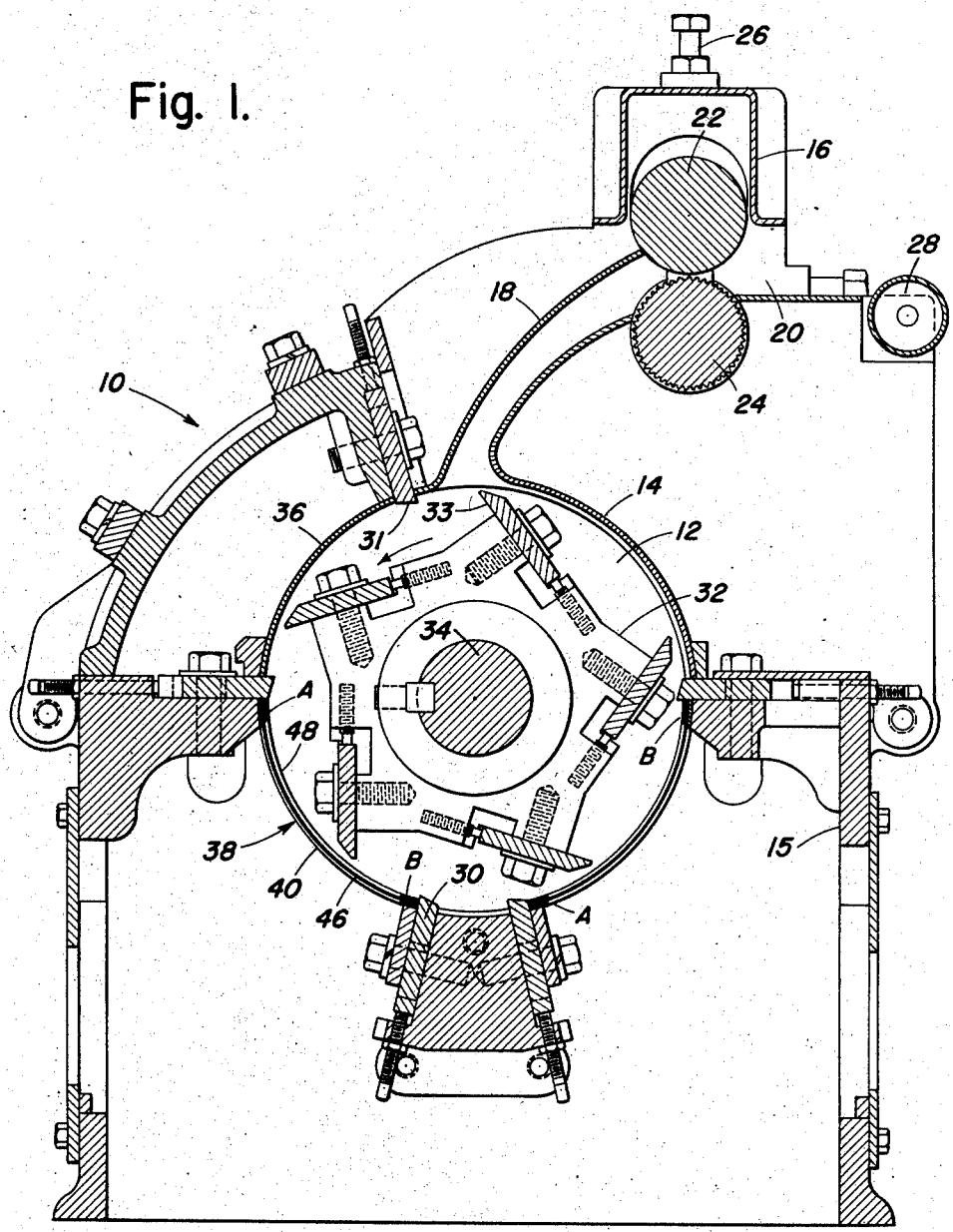
June 16, 1959 F. L. FLETCHER ET AL 2,890,840

SCREEN PANEL FOR ROTARY-KNIFE CUTTER MACHINES

Filed June 15, 1956 2 Sheets-Sheet 1

Fig. 1.



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Filed June 15, 1956 2 Sheets-Sheet 2

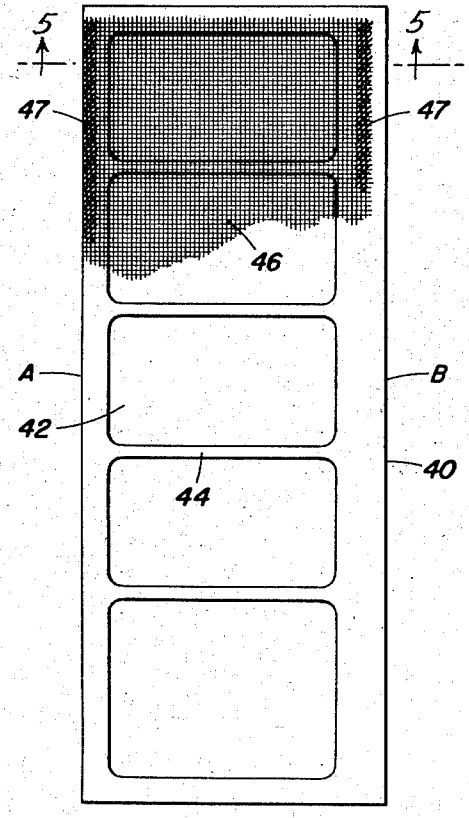


Fig. 2.

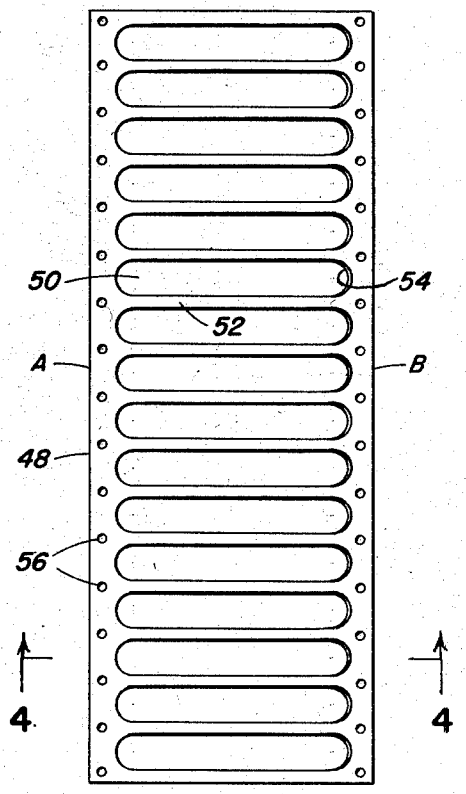


Fig. 3

Fig. 5.

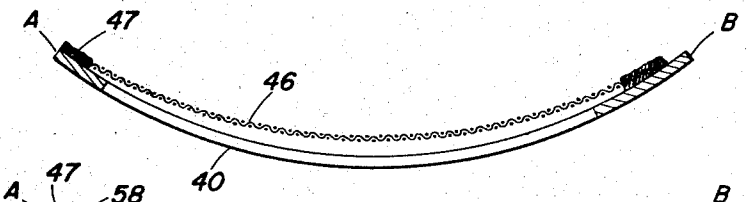


Fig. 6.

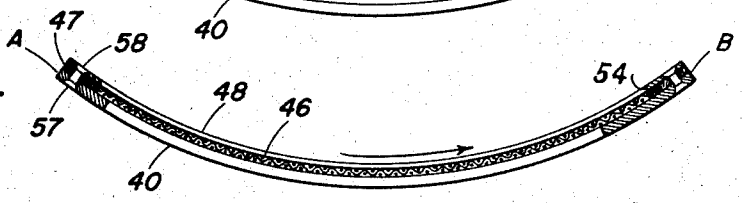
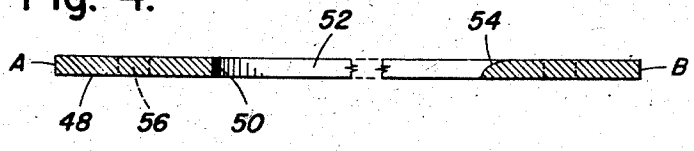


Fig. 4.



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SCREEN PANEL FOR ROTARY-KNIFE CUTTER MACHINES

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1 Claim. (Cl. 241—73)

This invention relates to a screen panel. More particularly it relates to a screen panel adapted for use in rotary-knife cutter machines.

In Perry's Chemical Engineers' Handbook, third edition, on pages 1160–1162, there are described various types of rotary-knife cutter machines. Such machines are useful for the comminution of tough, fibrous materials which are not readily reduced in size in other type comminution devices such as rod mills, hammer mills, etc. Thus, these machines are particularly useful in the comminution of asbestos, cocoanut shells, paper and leather.

A typical rotary-knife cutter machine, such as shown in Perry's Handbook on page 1161 in Fig. 62, essentially comprises a cylindrical cutting chamber comprising feed means for uncomminuted materials, a rotatable shaft or rotor along the central axis of the chamber, rotatable or fly knives associated with the rotor, and stationary or bed knives positioned about the periphery of the chamber. At least part of the cylindrical wall of these machines comprises screen paneling through which materials which have been comminuted to the desired particle size are removed from the cutting chamber. These screen panels control the product size.

In machines heretofore used, each screen panel has usually comprised a rectangular support frame having a radius of curvature and, soldered on the concave side thereof, a wire mesh screen cloth. The frame or panel may be subdivided or partitioned in order to lend structural strength to the panel and to help support the screen cloth, the openings between the partitions permitting the passage through the screen cloth of comminuted materials from within the cutting chamber to the outside of the cutting chamber. The radius of curvature will usually approximate that of the inside cylindrical periphery of the cutting chamber.

We have found, however, that the screen panels on these machines do not have a very long life, particularly in the comminution of cellulose sheet wherein fine mesh screen cloth (50–60 mesh) comprised of relatively fine wire has been employed. Under use conditions, we have found that the wire in the screen cloth tends to break adjacent the edge of the support frame after a relatively short period of operation (less than 24 hours being not uncommon) resulting in high maintenance costs and the appearance of undesired coarse particles in the comminuted product.

As a result of our investigations we have reached the conclusion that such breakage is actually a fatigue failure and that such is undoubtedly due to the pulsating or fluttering that results from the rotation of the fly knives as well as pressure exerted on these screens by the cutting chamber contents.

It is an object of this invention, therefore, to improve the screen panels in such a way as to increase the useful life of such screens.

More specifically, it is an object of this invention to provide the art with an improved screen assembly in which the pulsations and pressures that might be exerted

thereon by materials undergoing comminution will have little adverse effect. Moreover, it is a specific object of this invention to obtain a screen assembly wherein pulsation and fluttering of the screen cloth under operative conditions will be considerably dampened.

Still another object is to provide the art with rotary-knife cutter machines adapted with screen paneling having a fairly long operational life.

These and other objects which may appear as this specification proceeds are achieved by this invention which, in summary, comprises a screen panel in which the screen cloth is established and maintained under tension to resist forces exerted on the screen cloth under operative conditions and which is adapted with means to substantially dampen pulsation and fluttering during the operation of the rotary-knife cutter machine.

In a preferred embodiment of this invention, the screen panel comprises the combination of a back-up plate, screen cloth, and a hold-down plate and means for attaching said hold-down plate to said back-up plate with the screen cloth in between.

The back-up support plate comprises a thin frame in the shape of a right angle parallelogram having a radius of curvature along the lateral dimension thereof and partitioned by at least one lateral partition member or screen supporting rib whereby screen panel outlet openings are provided. Such means also function to lend structural strength to both the back-up plate and the hold-down plate.

The screen cloth is of the conventional type, being produced from relatively fine wire. It is cut in the shape of a right angle parallelogram and with its lateral dimension slightly less than the lateral dimension of the back-up plate without its radius of curvature.

The hold-down plate functions to establish and maintain the screen cloth under tension so that it can resist pulsations under operative conditions. It also functions to dampen such pulsation as may occur under operative conditions. Accordingly the hold-down plate provides a surface contact area with the screen cloth at a plurality of points uniformly distributed over the screen cloth while providing an adequate screen area for the passage of comminuted materials. Thus, in the preferred embodiment, the hold-down plate comprises a thin frame in the shape of a right angle parallelogram having a radius of curvature along the lateral dimension thereof, which radius is the same as that of the back-up support plate, and subdivided by a number of parallel partition members of relatively more inflexiblity than the screen cloth and laterally disposed along the longitudinal dimension thereof to form a plurality of elongated slot-like openings. The number of ribs should be sufficient to provide an adequate area for the passage of comminuted materials of desired product size therethrough while providing a uniformly distributed, screen cloth contact, surface area of sufficient degree to dampen pulsation of the screen cloth under ordinary operative conditions. The ribs in their lateral dimension have the same radius of curvature as the frame.

The screen panel is assembled in the following manner. First, the screen cloth is soldered or otherwise attached to the concave side or surface of the back-up support plate in such a manner that it has a slightly greater radius of curvature than the back-up support plate whereby there is a small clearance between the screen cloth and the back-up plate at the center of the arc of the screen cloth and of the back-up plate. The hold-down plate is then placed with its convex side or surface on top of the screen, and compressed the full limit to the back-up plate whereby the screen cloth is stretched and maintained under uniform tension. The hold-down plate is then attached to the back-up plate with rivets or the like. The

screen panel is then ready for insertion into the casing of the rotary-knife cutter machine.

Under use conditions, particularly when comminuting cellulose and the like, we have observed a tendency for comminuted materials to accumulate and become impacted between the hold-down plate and the screen cloth at the trailing end (with reference to the direction of rotation of the fly knives of the rotary-knife cutter machine) of each of the slot-like openings of the hold-down plate, with the result that the wire mesh of the screen cloth tends to fracture and break adjacent said end. Apparently, the impacted material stretches the wire, making it more susceptible to failure adjacent to the point of contact of the screen cloth with the impacted material. We have discovered that this condition can, for all practical purposes, be eliminated by tapering the trailing edge of each of the openings in the hold-down plate from the convex side of the hold-down plate to the concave side thereof in the direction of the trailing edge of the hold-down plate. Apparently this tapering surface functions to deflect passing particles of comminuted material away from the hold-down plate in contrast to an abrupt break in the surface which tends to entrap said particles.

Before proceeding to a description of the drawings it should be understood that this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof and that the embodiments shown in the drawings are therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them and all changes that fall within the metes and bounds of the claim and of forms that are their functional as well as conjointly cooperative equivalents are intended to be embraced by the claim. Thus, where reference is made to rectangular shape, it will be understood that the description could apply to square shape.

With reference to the drawings, it will be observed that:

Fig. 1 is a side cutaway view of a rotary-knife cutting machine provided with the improved screen panels of this invention;

Fig. 2 is a plan view of the concave face of the back-up plate of this invention with a mounted screen cloth partially cut away;

Fig. 3 is a plan view of the top side of a hold-down plate prior to giving it a radius of curvature;

Fig. 4 is a magnified cross-sectional view taken along the line 4—4 of Fig. 3 and presented for the purpose of showing the tapered trailing edge of the slot-like openings in the hold-down plate;

Fig. 5 is a magnified sectional view taken along 5—5 of the screen cloth and back-up plate of Fig. 2, prior to the placement of a hold-down plate thereon; and

Fig. 6 is a side view of a screen panel ready for insertion into the rotary-knife cutting machine, which screen panel has been slightly modified over that which would result from the screen cloth and back-up plate combination of Fig. 5.

In somewhat more detail, the drawings disclose a rotary-knife cutter machine **10** comprising a cylindrical cutting chamber **12** enclosed by a casing **14**, a support structure **15** and an infeed means **16**. In the embodiment shown in the drawings the infeed means is especially adapted for sheet cellulose although other means, such as those disclosed in Perry's Handbook, can be used. In any event, the infeed means **16** of the embodiment disclosed comprises a feed chute section **18** associated with the top portion of the casing **14**, which section has an infeed entrance **20** in which, laterally disposed to the entrance, are a rotatable smooth roll **22** and a rotatable corrugated roll **24**. These rolls are provided with adjustment means **26** for regulating the nip action of the rolls. Situated adjacent the feed entrance **20** is an idler roll **28** for aiding the movement of cellulose sheet through the feed entrance.

Within the cylindrical cutting chamber **12** there are a number of stationary or bed knife assemblies **30** spaced about the inside periphery of the chamber. Each stationary knife assembly comprises a stationary cutter blade or bed knife **31** positioned with the knife edge disposed parallel to the longitudinal axis of the chamber, and means for adjusting the extent of protrusion of the bed knife into the cutting chamber **12**. Also disposed within the cylindrical cutting chamber are a number of rotatable knife assemblies **32**, each having a cutter blade or fly knife **33** with its knife edge stationed parallel to the longitudinal axis of the cutting chamber **12**, and means for adjusting the extent of protrusion of the fly knife into the cutting chamber. These rotatable knife assemblies **32** are spaced about, and affixed to, a rotor **34** which extends along the longitudinal axis of the cutting chamber **12**.

The cutting chamber is enclosed by a cylindrical casing having impermeable panel members **36** on the top portion thereof and, on the bottom portion thereof, screen panel members **38** with means for holding the panel members in place. In the drawings these means are associated with the bed knife assemblies **30**.

Each screen panel member **38** of this invention comprises a back-up plate **40** formed by a thin, rectangular frame having a radius of curvature along its lateral dimension, and having a longitudinal leading edge A and a longitudinal trailing edge B. The back-up plate **40** is subdivided into a number of openings **42** by partition members **44**.

On the concave face of the back-up plate **40** and covering the back-up plate openings **42** there is disposed a screen cloth **46** of general rectangular shape with its lateral dimension slightly less than that of the back-up plate without its radius of curvature (laid out flat). One longitudinal edge of the screen cloth is positioned at the leading edge A and attached to the concave side of the back-up plate **40** by a strip of solder **47**. The other longitudinal edge of the screen cloth is positioned near the trailing edge B of the back-up plate, as in Figs. 2 and 5 or at the trailing edge as in Figs. 1 and 6 but in any case it is positioned so that it has a radius of curvature slightly greater than that of the back-up plate **40**. This edge of the screen cloth is also attached to the back-up plate by a strip of solder **47**.

On top of the screen cloth **46** is arranged a hold-down plate **48** comprised of a thin, rectangular frame having a radius of curvature equal to that of the back-up plate **40** and subdivided into a plurality of lateral slots or openings **50** by partition members **52**. In the embodiment shown, it will be observed that the hold-down plate likewise has a longitudinal leading edge A and a longitudinal trailing edge B with the slots **50** of the hold-down plate being beveled towards the concave side of the hold-down plate at the trailing edge **54** of each slot. It will also be observed that adjacent the leading edge A and the trailing edge B there are a number of equally spaced rivet holes **56**.

The screen cloth **46** is under tension in the screen assembly and is so placed under tension by first mounting as described the screen cloth on the concave face of the back-up plate **40**, then placing the convex side of the hold-down plate **48** against the screen cloth, and, finally compressing together the back-up plate **40** and the hold-down plate **48** by means of C-clamps and the like.

The degree of clearance between the screen cloth and the back-up plate **40** will vary according to the type of screen cloth and the lateral dimensions of the screen cloth and back-up plate. Generally speaking, the degree of clearance should be such that the subsequent compression of the screen cloth by the hold-down plate will cause the cloth to stretch laterally without relaxation and without

breaking the lateral wire strands of the cloth and lie substantially flat against the concave face of the back-up plate. Thus, with a back-up plate having the dimensions 18 and 15/32 x 7 and 1/8 inches and an inside radius of curvature of 5 and 1/2 inches and with a 50 x 50 mesh, twilled weave, Type 304 stainless steel wire (0.011 inch diameter) screen having the dimensions of 17 and 7/8 x 6 and 5/8 inches, we have found that 3/32 of an inch clearance at the center of the arc of the back-up plate, prior to positioning of the hold-down plate, is satisfactory.

Incidentally the hold-down plate used in conjunction with the foregoing specifically described back-up plate had a frame measuring 17 and 7/8 x 6 and 5/8 inches with 15 ribs measuring 3/32 of an inch wide. The slots were 5 and 3/8 inches long and 13/16 of an inch wide. Moreover, the back-up plate was partitioned by 4 partition members, each 3/32 of an inch wide and 5 and 3/8 inches long whereby four openings having a longitudinal dimension of 3 inches and a fifth opening having a longitudinal dimension of 4 and 3/32 inches were formed.

Although not indicated in the drawings, the lateral ends of the screen cloth can be flattened against the back-up plate **40**, as by a template or a series of small C-clamps or the like, and soldered to the concave face of the back-up plate before placing the hold-down plate **48** over the screen cloth. This tends to prevent leakage of unwanted coarse, comminuted materials from the ends of the screen panel under operative conditions.

To complete the assembly operation, rivet holes **57** are drilled through the back-up plate **40** and in alignment with the rivet holes **56** of the hold-down plate **48**, rivets **58** are inserted and riveted into place. The C-clamps can then be removed and the screen assembly is ready for use as a screen panel member **38**.

The lateral dimensions of the hold-down plate and the back-up plate may vary depending on the requirements of the rotary-knife cutter machine or other machine in which the screen panel is to be used. Thus, the lateral dimension of the hold-down platen may be less than that of the back-up plate as would be the case in Fig. 5. The lateral dimensions can also be substantially the same as in Figs. 1 and 6. These dimensions however are not critical insofar as this invention is concerned except that the lateral dimension of the hold-down plate should, generally speaking, be great enough to cover the soldered or otherwise attached portion of the screen cloth.

In any event it is a feature of this invention that the screen cloth in the panel is established and maintained under tension and in contact with a sufficient and uniformly distributed surface of greater inflexibility than the screen cloth so that it will not pulsate or flutter to any substantial extent. Moreover, it is another feature of this invention that comminuted particles are prevented from accumulating between the screen cloth and the hold-down plate, wherefore a non-uniform tension on the screen that ultimately would lead to a breakage is prevented.

The screen panel of this invention has, under operative conditions in a rotary-knife cutter machine, been very successful. Whereas, prior to this invention, the operational life of the screen panels was often less than 24 hours in a rotary-knife cutter machine, such as illustrated in Fig. 1, that was operated at a rotor speed of 920 r.p.m. to comminute cellulose sheets to particles finer than 50 mesh, the screen panels of this invention under substantially the same operational conditions have achieved an operational lifetime of as much as 3032 hours without failure. Thus, the screen panels of this invention represent a vast improvement over conventional screen assemblies.

Another advantage of the screen panel of this invention is the ease with which the individual components can be fabricated and then assembled to form the panel. Thus, the back-up plate and the hold-down plate (as in Figs. 3 and 4) can be fabricated from sheet metal and then rolled to a desired radius of curvature with conventional equipment.

What is claimed is:

A screen panel useful in rotary-knife cutter machines, which comprises a back-up plate; a screen cloth; a hold-down plate; and means for attaching said hold-down plate to said back-up plate with said screen cloth in between; said back-up plate comprising a thin frame in the shape of a right angle parallelogram having a radius of curvature, whereby said plate has a concave surface with a leading edge and a trailing edge, said surface comprising at least one screen supporting rib disposed between said leading edge and said trailing edge in the direction of curvature whereby screen panel outlet openings are provided; said screen cloth being located on the concave surface of said plate and attached to said back-up plate adjacent its leading edge and also within the vicinity of the trailing edge to thereby cover said outlet openings while being under tension in the direction of curvature; said hold-down plate comprising a thin frame in the shape of a right angle parallelogram having a radius of curvature substantially the same as that of said back-up plate, whereby said hold-down plate has a convex surface with a leading edge and a trailing edge, said surface comprising a plurality of pulsation dampening ribs disposed between said leading edge and trailing edge in the direction of curvature whereby slot-like infeed openings are provided, the spacing between said ribs being sufficient to substantially dampen screen pulsations of said screen cloth under operative conditions while providing substantial infeed area in each of said openings, said hold-down plate also comprising a concave surface on the side opposite the convex surface with the trailing end of each of said slot-like infeed openings being tapered from adjacent the convex side to said concave side towards the trailing edge of said plate.

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