Jan. 17, 1967 A. R. LE COMPTE, JR 3,298,904

BELT CLEANING APPARATUS FOR A PAPERMAKING MACHINE

Filed Aug. 10, 1964 3 Sheets-Sheet 1

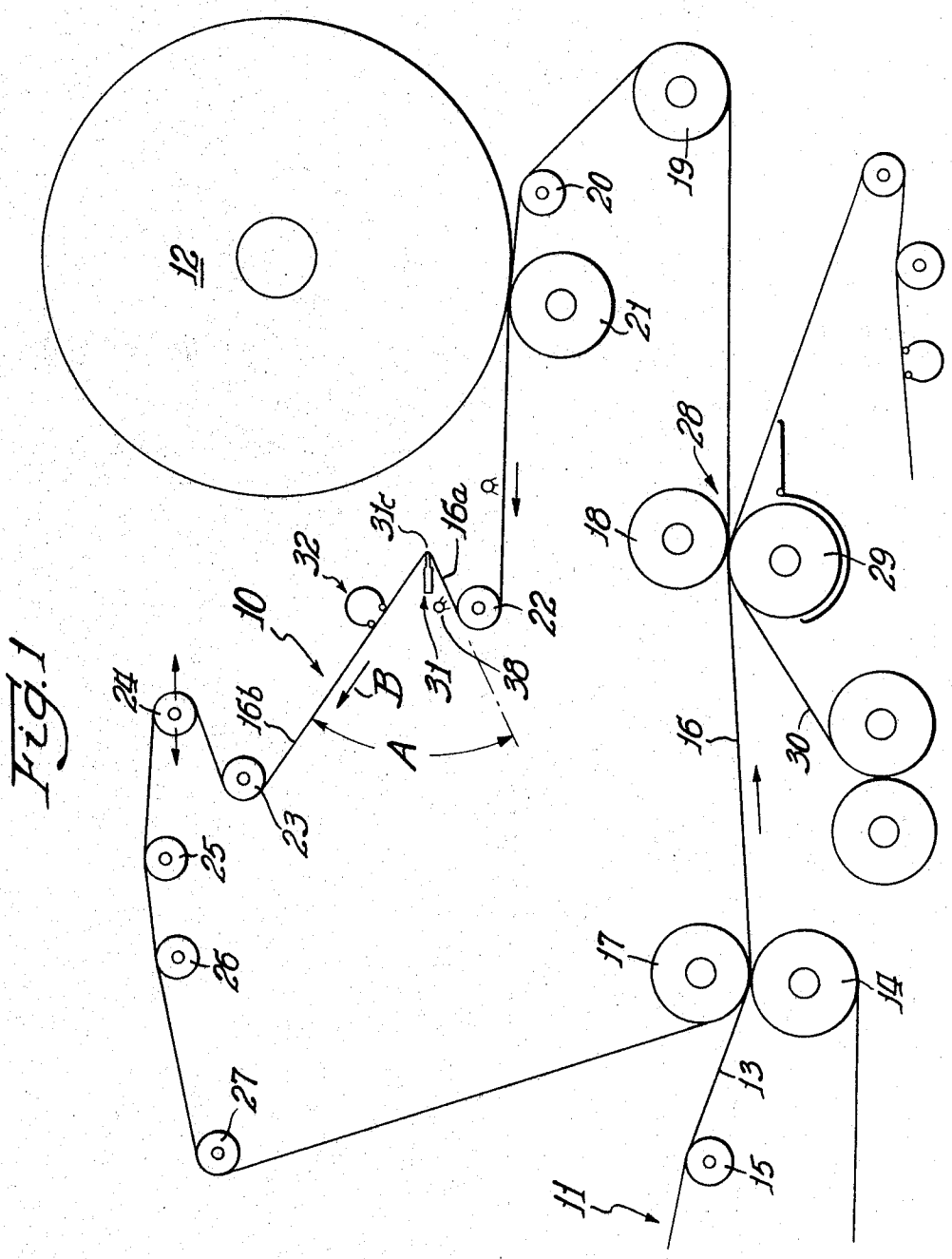

Fig. 1

Jan. 17, 1967 A. R. LE COMPTE, JR 3,298,904

BELT CLEANING APPARATUS FOR A PAPERMAKING MACHINE

Filed Aug. 10, 1964 3 Sheets-Sheet 2

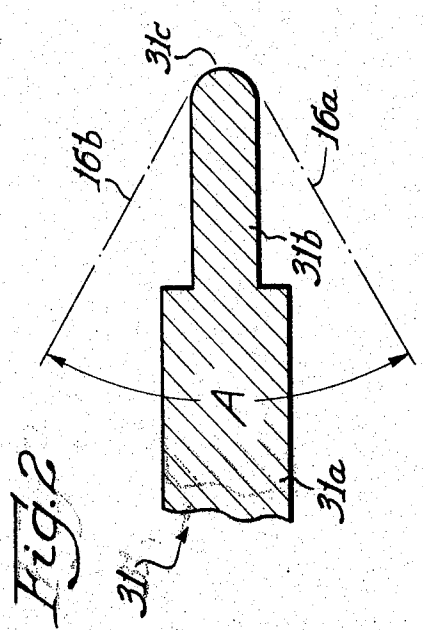

Fig. 2

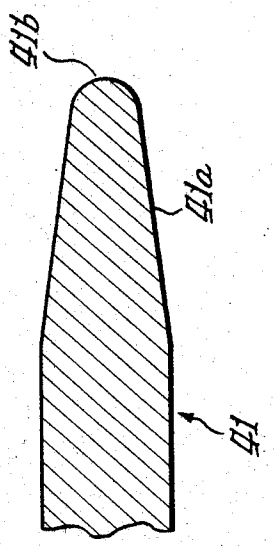

Fig. 6

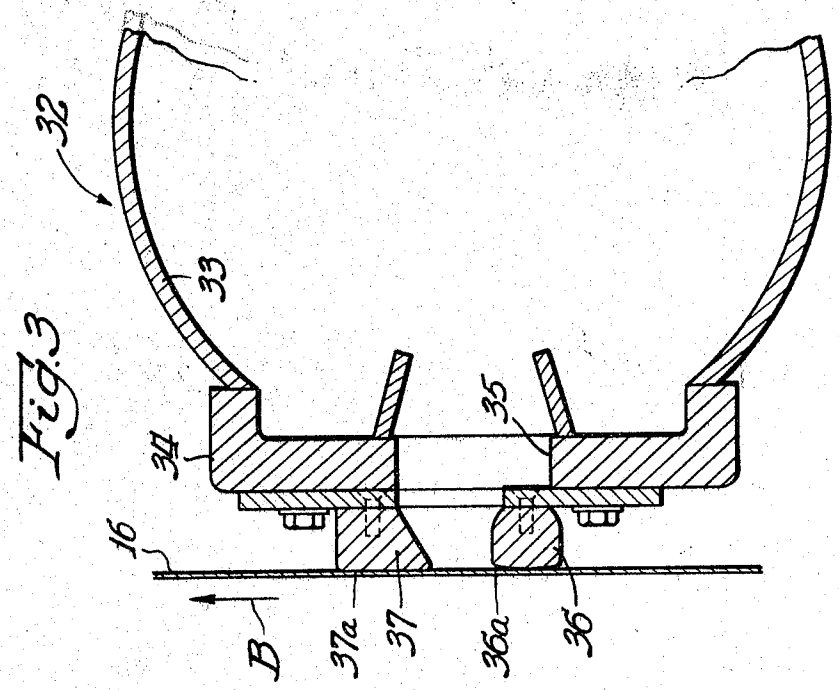

Fig. 3

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BELT CLEANING APPARATUS FOR A PAPERMAKING MACHINE

Filed Aug. 10, 1964 3 Sheets-Sheet 3

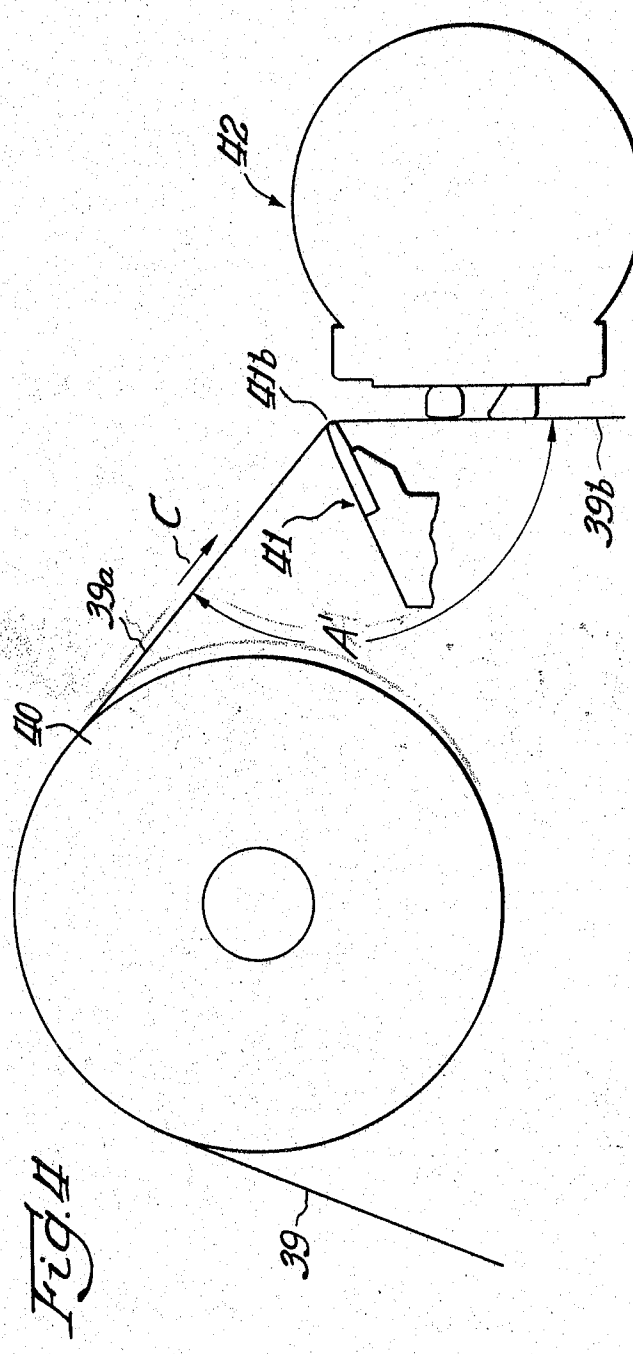

Fig. 4

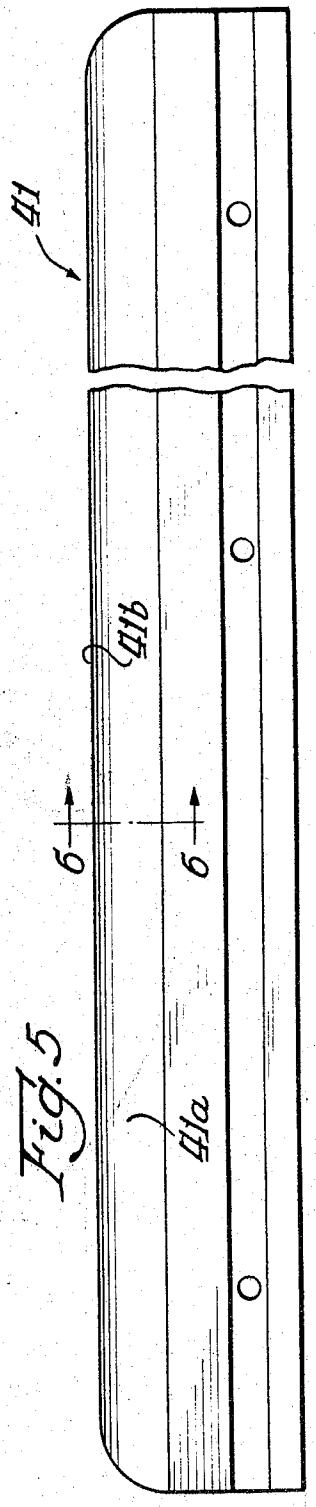

Fig. 5

United States Patent Office 3,298,904 Patented Jan. 17, 1967

3,298,904

BELT CLEANING APPARATUS FOR A PAPERMAKING MACHINE

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4 Claims. (Cl. 162—274)

My invention relates to papermaking machines and more particularly to devices for cleaning the felts of such machines.

Various expedients have previously been applied for maintaining the felts of papermaking machines clean so that the felts may dewater the paper webs carried by them uniformly and to the greatest extent possible. Such cleaning expedients have, for example, included the use of suction boxes effective on exterior surfaces of the felts, the use of soaps and even acids for washing the felts, the use of water showers, and the use of scraping guardboards on exterior felt surfaces. In general, these cleaning arrangements utilize a considerable amount of water, and they are not economical for this reason.

It is an object of the present invention to provide an improved cleaning device for the felts of papermaking machines. In a preferred form, the cleaning device of the invention uses a member having a rounded, small diameter edge which is held in forceful contact with the inside surface of a papermaking machine felt for causing compression of the felt as it passes over the rounded edge, so that water within the felt passes through the felt on to the outer felt surface to provide a wet, slick outer felt surface. The water passing through the felt on to its outer surface carries with it soil within the felt and floats this soil, as well as the soil adhering to the outer surface of the felt, in the pool of moisture on the outer felt surface. The invention contemplates also the provision of a suction box located close to the member with the rounded edge and effective on the outer felt surface as the felt leaves the rounded edge, for removing the moisture and the soil carried by the moisture from the outer felt surface and thereby cleaning the felt.

The invention consists of the novel constructions, arrangements and devices to be hereinafter described and claimed for carrying out the above stated objects, and such other objects, as will be apparent from the following description of preferred forms of the invention, illustrated with reference to the accompanying drawings, wherein:

FIG. 1 is a diagrammatic illustration of the felt section of a Fourdrinier papermaking machine and including a rounded edge member effective on the inside surface of the felt and a suction box effective on the outer surface of the felt and located adjacent to the rounded edge member in the direction of movement of the felt;

FIG. 2 is a fragmentary sectional view of the rounded edge member;

FIG. 3 is a fragmentary sectional view of the suction box;

FIG. 4 is a fragmentary diagrammatic illustration of another installation of a rounded edge member and suction box on a felt of a papermaking machine;

FIG. 5 is a plan view of the rounded edge member illustrated in FIG. 4;

FIG. 6 is a sectional view on an enlarged scale taken on line 6—6 of FIG. 5.

Like characters of reference designate like parts in the several views.

Referring now to the drawings and in particular to FIG. 1, there is illustrated a felt section 10 of a papermaking machine located between the Fourdrinier section 11 and a steam heated Yankee drier 12. The Fourdrinier section 11 comprises the conventional Fourdrinier wire

13 supported by a plurality of rolls including a couch roll 14 and a support roll 15. The usual fibrous slurry is applied to the wire 13 for forming a paper web on the wire.

The felt section 10 comprises an endless felt 16 supported by a plurality of rolls 17, 18, 19, 20, 21, 22, 23, 24, 25, 26 and 27. The roll 17 is a pickup roll holding the felt 16 in contact with the Fourdrinier wire 13 for picking up the wet paper web formed on the Fourdrinier wire 13 and causing it to transfer to the outer surface of the felt 16. The roll 18 constitutes one roll of a felt press 28 having a second roll 29 positioned to have a nip with the roll 18. The felt 16 passes between the rolls 18 and 29, and an endless bottom felt 30 also passes between the rolls 18 and 29. Since the bottom felt 30 is conventionally used, only a portion of it is illustrated.

The roll 21 is a pressure roll which has a nip with the drier 12, and the felt 16 passes between the roll 21 and the drier 12 and causes the paper web which travels on the exterior surface of the felt 16 to transfer from the felt on to the outer surface of the drier 12. The roll 24 is a stretch roll which is so movable on its mountings that the felt 16 may be tightened or loosened about its supporting rolls. The roll 25 is a guide roll one end of which may be adjustably moved for the purpose of causing the felt 16 to move in the same continuous path about its supporting rolls. The other rolls 19, 20, 22, 23, 26 and 27 are simply turning rolls functioning to support the felt 16 in a continuous loop.

A member 31, which is simply a sheet material strip having a rounded, small diameter working edge, is in forceful contact with the inner surface of the felt 16 between the rolls 22 and 23 and holds the felt between the rolls 22 and 23 with an incoming felt stretch 16*a* between the roll 22 and the member 31 extending at a certain included angle A with respect to an outgoing felt stretch 16*b* that extends between the member 31 and the roll 23. The felt 16 travels in the direction indicated by the arrow B so that the felt stretches 16*a* and 16*b* are respectively incoming and outgoing felt stretches with respect to the member 31 respectively approaching and leaving the member 31. A suction box 32 is positioned adjacent the member 31 to be effective on the outer surface of the outgoing stretch 16*b* of the felt between the member 31 and the roll 23.

Referring in particular to FIG. 2, which illustrates the member 31 in greater detail, it will be observed that the member 31 is a sheet material strip with a relatively thick base portion 31*a* and a relatively thin stepped down edge portion 31*b* which is provided with a rounded end 31*c*. The portion 31*a* may, for example, be ½ inch in thickness; the portion 31*b* may, for example, be ¼ inch in thickness; and the radius of the rounded end 31*c* may, for example, be ⅛ inch. The member 31 may be of any suitable material such as hardwood, Monel metal, stainless steel, etc. The member 31 is supported by any suitable supporting means so as to hold the felt 16 in its illustrated configuration with the angle A between the ingoing portion 16*a* of the felt and the outgoing portion 16*b* of the felt.

The suction box 32 may be of any suitable type and may comprise, for example, referring to FIG. 3, a hollow metal shell 33 connected to any suitable source of vacuum (not shown). A cover 34 is fixed to the shell 33 and is provided with a vacuum slot 35 extending longitudinally with respect to the shell 33 and cover 34. An incoming lip 36 having a rounded surface 36*a* in contact with the felt 16 is fixed on one side of the slot 36, and an outgoing lip 37 having a flat surface 37*a* is provided on the other edge of the slot 35. The felt 16 passes between the lips 36 and 37 in the direction indicated by the arrow in B in FIG. 3.

Suitable water showers are provided in connection with the felt **16**, and one of these may be a water shower **38** positioned to spray water on to the incoming stretch of felt **16** just prior to the member **31**.

It will be observed that the included angle A between the incoming and outgoing stretches of felt, as shown in FIGS. 1 and 2, is approximately 60°. FIG. 4 illustrates a portion of a felt section of a papermaking machine in which the corresponding angle is considerably larger. The felt section partially illustrated in FIG. 4 comprises an endless felt **39** disposed over a supporting roll **40**. The felt **39** passes over a member **41** with a rounded edge in contact with the felt and under a suction box **42**. The member **41** is so disposed with respect to the supporting rolls for the endless felt **39** that there is an included angle A' of about 130° between the incoming stretch **39***a* of the felt and the outgoing stretch **39***b* of the felt, the felt traveling in the direction from the roll **40** to the member **41** as shown by the arrow C.

Referring to FIGS. 5 and 6, it will be observed that the member **41** constitutes a strip of sheet material, and the strip is tapered at **41***a* and is provided with a rounded working edge **41***b*. The member **41** may have a thickness of ½ inch, for example, and the radius of the rounded edge **41***b* may be ⅛ inch, for example.

The suction box **42** may be identical with the suction box **32** illustrated in the first described embodiment.

The rounded edge members **31** and **41** in cooperation with the suction boxes **32** and **42** function to clean the endless felts **16** and **39**, particularly the outer surfaces of these felts which carry the paper webs being dewatered by the felts and which accumulate debris and soil from these paper webs. It is necessary for the economical and proper operation of a papermaking machine to maintain the felts clean so that they may dewater the webs to the greatest extent possible and so that dewatering of the webs is uniform. If the dewatering is not uniform objectionable sheet defects appear in subsequent pressing and drying operations.

It will be observed that the ends **31***c* and **41***b* of the members **31** and **41** are rounded with small radii. The felts **16** and **39** are kept under a certain tension, such as, for example, 17 pounds per lineal inch and which may well vary between 15 pounds per lineal inch and 25 pounds per lineal inch; and, as the felts pass over the rounded ends **31***c* and **41***b* of the members **31** and **41**, the felts are compressed on these rounded ends **31***c* and **41***b*. The water carried by each felt is thus driven out of the felt on to its exterior surface; and the water in moving out of the felt floats the soil on the outer surface of the felt. Enough water is carried by the felt so that it is supersaturated at the pressure exerted by the members **31** and **41** at the working edges **31***c* and **41***b* of the members.

There thus exists on the outer surfaces of the felts **16** and **39** a wet, slick surface due to the compression of the felts as they pass over the rounded ends **31***c* and **41***b*; and the suction boxes **32** and **42** are located very near to the members **31** and **41** on the stretches of the felts which are outgoing with respect to the members **31** and **41**, so that this moisture and the soil carried by the moisture on the outer surfaces of the felts are sucked into the suction boxes **32** and **42** for removing the soil from the felts and thus cleaning the felts. Each of the suction boxes positioned downstream of a member **31** or **41** may well be located from 6 inches to 2 feet from the member **31** or **41** on the outgoing stretch of the felt for proper removal of the moisture and soil on the outer surface of the felt. Inasmuch as there is an included angle between the ingoing and outgoing stretches of the felts passing to and from the members **31** and **41**, the felts change directions in passing over these members **31** and **41**, and centrifugal force thus also is effective in removing the moisture and soil from the felts in the vicinity of the members **31** and **41**.

The included angle between the ingoing and outgoing stretches of the felts, that is the stretches of the felts passing to and from the members **31** and **41**, may vary considerably, such as between 5° and 178°. It is basically only necessary to have a rigid edge in forceful contact with one surface of the felt for squeezing and compressing the felt as th felt passes over the edge, so that the moisture in the felt moves to the other felt surface and floats the soil on this felt surface for removal by an associated suction box located downstream with respect to the rigid edge. The desirable included angle between the incoming and outgoing stretches of felt to and from the rounded edge member is dependent on a number of factors including machine or felt speed. If the machine speed is slow, a large amount of wrap around the rounded edge member or a small included angle between the incoming and outgoing felt stretches may successfully be used. For example, if the speed of the machine is about 100 to 200 feet per minute, conceivably the included angle could be just under 180°. For higher machine speeds, the wrap should preferably be less (the included angle should be larger) in order to avoid tearing the felt. A limiting factor for the included angle is the wear of the rounded edge member on the felt which increases with the wrap, and excessive felt wear also dictates that the wrap should preferably be less for higher machine speeds than for lower machine speeds. It will be noted that the included angle A in the first described embodiment is about 60°. This angle has been found quite desirable for use on top felts in machines having speeds of 3,000 to 3,500 feet per minute.

The included angle or the amount of wrap around the edges of the rounded edge members also depends on the porosity of the felt and the hardness or compressibility of the felt; and, in addition, the wrap depends on the lubrication that is used with the felt. It may be mentioned at this point that the provision of a water shower on the incoming stretch of the felt just prior to the rounded edge member, such as the shower **38**, for example, is useful for lubricating purposes.

The general construction of the felt also is important in determining the desirable amount of wrap. The rounded edge members on the inside surfaces of the felts, according to the teachings of the invention, have been found effective and advantageous in connection with both the conventional types of felts and also for needled felts. In view of the fact, however, that conventional felts are more rugged and hard than are the needled felts, the included angle between the incoming and outgoing stretches of conventional felts may be smaller than for the needled felts, considering the excessive wear that might result to the needled felts with smaller included angles.

It will be appreciated also that the contact time of the felt on the rounded edge members, which is in the order of micro-seconds for ordinary machine speeds, is important; since the water within the felt has mass and must be accelerated from within the felt to its outer surface as the felt passes around the rounded working edge of the members and is thereby compressed. More wrap or a less included angle obviously provide more contact time of the felt on a rounded edge member and provide a greater area and time of compression of the felt, with a greater tendency for moisture to be extruded through the pores of the felt on to its outer surface. From this standpoint, a smaller included angle is desirable.

Although the rounded edges **31***c* and **41***b* have been described as having ⅛ inch radii, which is a good working radius for such members, nevertheless this radius can vary considerably, as from .050 inch to 2 inches.

The desirable radius on the rounded edges of the members of the invention is dependent on a number of factors. These include the machine speed, the felt compressibility or hardness, and the openness of the felt. It might be mentioned that a very open felt, such as a bottom felt, can successfully use a very large radius, such as 2

inches. On the other hand, if the rounded edge member is used with a top felt more closed in character, smaller radii are more desirable. The radius on the edge of the member for a needled felt should, other factors being the same, be greater than for conventional felts, since the needled felts are not as rugged and hard as are the conventional felts. The wear of the rounded edge member on the felt also is a limiting factor in selecting a proper radius—an unduly sharp working edge obviously will cause greater and undue wear on the felt.

The wear on the felt and the compression to which the felt is subjected as it passes around the edge of the rounded edge member is obviously dependent on the amount of static pressure that the felt is subjected to at this point. The included angle or amount of wrap determines the total force force that is applied to the rounded edge member, and the static pressure of the felt on the rounded edge is determined only by the felt tension and the radius of the working edge of the member as will now be described. The static pressure exerted by the rounded edge in pounds per square inch equals T/R, where T is the tension on the felt in pounds per lineal inch and R is the radius in inches of the rounded edge. A common tension on a top felt is 17 pounds per lineal inch and assuming a ¼ inch radius of a rounded edge, there will exist a static pressure of the rounded edge member on the felt of 17 divided by ¼, or 68 pounds per square inch. As has been above mentioned, top felt tensions may well vary in ordinary practice between 15 pounds to 25 pounds per lineal inch.

It may be noted that the incoming lip of a conventional suction box of the type illustrated in FIG. 3 is round in cross section, and such lips commonly have a diameter of about 1 inch. It is contemplated, however, that the rounded surface **36***a* of the lip **36** that contacts with the felt **16** for this application should preferably be of decreased curvature to have a radius of 4 to 5 inches, for example. Any compressive effect of the incoming lip **36** on the felt as the felt passes over the incoming lip is thus reduced to prevent any pushing of the soil back into the felt from its outer surface. The compressive effect of the lip **36** may be calculated with the same formula as above mentioned, $P=T/R$, where P is the pressure of the lip on the felt in pounds per square inch, T is the tension of the felt in pounds per lineal inch and R is the radius of the surface contacting the felt.

The above described rounded edge members forcefully pressing on the inside surfaces of the felts advantageously super-saturate the felts in the areas of the felts in contact with the rounded edges so as to cause the moisture within the felts to flow through the pores of the felts on to the outer surfaces of the felts. The movement of water from within the felts to their outer surfaces carries soil out of the felts and floats this soil, as well as that simply lying on the outer surfaces of the felts, so that the moisture and soil may be removed by the suction boxes located closely downstream. The centrifugal force on the felts as they pass around the rounded edge members also helps in removing the moisture and soil from the felts. The rounded edge members thus effectively clean the felts, and this cleaning may be effectively accomplished using felts which carry less water than is usually carried by papermaking felts. Thus, since the felts may be effectively cleaned utilizing less water than previously, the rounded edge members are very desirable from an economic, required water supply, standpoint and from a stream pollution standpoint. Also, since the felts may be run drier than previously, there is less drying load on the papermaking machine, that is, the paper web may be transferred to the drier **12** in drier condition than would otherwise be possible.

I wish it to be understood that the invention is not to be limited to the specific constructions, arrangements and devices shown and described, except only insofar as the claims may be so limited, as it will be understood to those skilled in the art that changes may be made without departing from the principles of the invention.

What is claimed is:

1. In a felt cleaning arrangement for a papermaking machine, an endless felt movably supported by a plurality of supporting rolls and adapted to carry a wet paper web on its outer surface, a member having a rounded edge in forceful contact with the inside surface of said felt for compressing the felt as it passes over the rounded edge to force moisture out of the felt on to its outer surface, and a suction box effective on the outer surface on the stretch of the felt leaving said rounded edge at a place adjacent to said edge for removing said moisture and the moisture carried soil left by said web, said rounded edge having a radius between .050 inch and 2 inches and said suction box being located 6 inches to 2 feet from the rounded edge on said stretch of the felt leaving the rounded edge.

2. In a belt cleaning arrangement for a papermaking machine, an endless belt of compressible moisture absorbing material movably supported by a plurality of supporting rolls and adapted to carry a wet web formed from the fibrous slurry on a first one of its surfaces, a member having a rounded edge with a radius of .050 inch to 2 inches in forceful contact with the other surface of said belt for compressing the belt as it passes over the rounded edge, and a suction box effective on said first surface on the stretch of the belt between said rounded edge and the next adjacent one of said supporting rolls and leaving said rounded edge.

3. In a felt cleaning arrangement for a papermaking machine, an endless felt movably supported by a plurality of supporting rolls and adapted to carry a wet paper web on a first one of its surfaces, a member having a rounded edge in forceful contact with the other surface of said felt for compressing the felt as it passes over the rounded edge, and a suction device effective on said first surface on the stretch of the felt leaving said rounded edge at a place located within 2 feet from the rounded edge, said rounded edge having a radius between .050 inch and 2 inches.

4. In a felt cleaning arrangement for a papermaking machine, an endless felt movably supported by a plurality of supporting rolls and adapted to carry a wet paper web on a first one of its surfaces, a member having a rounded edge with a radius of .050 inch to 2 inches in forceful contact with the other surface of said felt, and a suction box effective on said first surface on the stretch of the felt between said rounded edge and the next adjacent one of said supporting rolls and leaving said rounded edge, said suction box having a pair of lips contacting the felt and the said lip more adjacent to said rounded edge being curved in cross-section on the portion of the lip in contact with the felt with a radius of curvature of at least 4 inches.

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