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(54) Hand or wiper towel.

(57) Hand or wiper towels are made according to a process which includes the steps of: forming a furnish of cellulosic fibers; depositing the furnish on a traveling foraminous belt , thereby forming a fibrous web on top of the traveling foraminous belt ; subjecting the fibrous web to non-compressive drying to remove the water from the fibrous web; and removing the dried fibrous web from the traveling foraminous belt . These hand towels possess high levels of absorbent capacity, absorbent rate, softness and strength .

Embossing of the hand or wiper towels enhances the superior qualities of the towels. In a preferred embodiment of the present invention, the transfer of the fibrous web from a foraminous belt of a higher speed to a foraminous belt of a lower speed produces a towel with enhanced strength and softness.

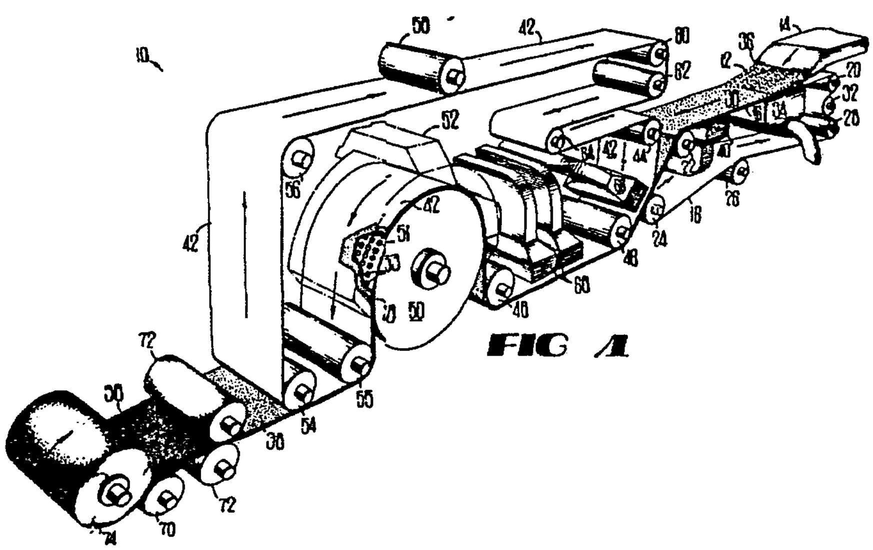

FIG 1

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HAND OR WIPER TOWEL

This invention relates to a paper towel.

Disposable paper towels are commonly manufactured and widely used. A primary function of these towels is absorbing liquid. Paper towels possess varying degrees of certain qualities which make them suitable for different tasks. Some of these qualities are softness, absorbent capacity, absorbent rate, and strength. The absorbent capacity is the maximum amount of liquid a paper towel can absorb, and the absorbent rate is the speed with which the paper towel can absorb liquid. The strength of a paper towel is generally the tensile strength of the paper towel which is a measure of the stress required to pull the paper towel apart.

Hand or wiper towels are a particular type of paper towel and are often used in washrooms for drying hands and for cleaning up liquid spills. These towels are also used for wiping surfaces clean with a solvent such as in washing windows or counter tops. Accordingly, towels must absorb relatively large quantities of liquid very quickly and possess enough strength so that they do not break apart when subjected to stress even when the towels are saturated with liquid. Further, it is also desirable for hand or wiper towels to be soft, particularly when the towels are used for drying hands so that they are comfortable to the user's skin and when wiping finished surfaces, such as desk tops or automobile exteriors, so that the towels do not scratch the finished surfaces.

Prior art hand or wiper towels which are made from cellulosic fibers are normally strong even when saturated with liquid, but often lack desirable levels of absorbent capacity, absorbent rate, and softness. These prior art towels are generally made with a conventional wet forming process wherein the beginning furnish contains chemical bonding agents to bind the cellulosic fibers together and promote the strength of the towel. The furnish is deposited on a traveling foraminous belt thereby forming a web of moist cellulosic fibers on top of the foraminous belt. The moist fibrous web is transferred to an absorbent carrier belt and then pressed by one or a series of rollers to remove water from the fibrous web and to compact the fibers in the web to further promote the strength of the towel. The pressed fibrous web is transferred to the outer surface of a rotating steam-heated dryer whereby part of the remaining water is evaporated from the fibrous web. The fibrous web is then "creped" by a blade positioned adjacent the outer surface of the dryer which scrapes the partially-dried fibrous web from the outer surface of the dryer. The creped fibrous web is then conveyed over a series of steam-heated dryers to evaporate the 20-50% moisture remaining in the web after creping. The creping enhances the absorbent capacity and absorbent rate of the towel

The conventional process for making soft paper towels is similar to the conventional process for making hand or wiper towels; however, creping of the fibrous web is done when moisture content has been reduced to 10% or less. An adhesive solution is also applied to the outer surface of the "Yankee" creping dryer so that the fibrous web adheres tightly to the surface of the dryer. The creped fibrous web requires no further drying in this process. The resulting soft towels possess high levels of absorbent capacity and absorbent rate; however, these soft towels are also very weak and tend to break apart when saturated with liquid. Accordingly, soft paper towels are not an adequate substitute for hand or wiper paper towels.

Therefore, there is a need for a hand or wiper paper towel which possesses a high level of strength as well as high levels of absorbent capacity, absorbent rate, and softness.

Therefore, an object of the present invention is to provide an improved hand or wiper towel.

Another object of the present invention is to provide a hand or wiper towel with high levels of absorbent capacity, absorbent rate, strength, and softness.

A further object of the present invention is to provide a hand or wiper towel at a reduced cost.

The present invention solves the above-described problems in the prior art by providing an improved hand or wiper paper towel. Generally, the present invention is a paper towel prepared by a process which includes the steps of: (1) forming a furnish of cellulosic fibers, water, and a chemical debonder; (2) depositing the furnish on a traveling foraminous belt, thereby forming a fibrous web on top of the traveling foraminous belt; (3) subjecting the fibrous web to non-compressive drying to remove the water from the fibrous web; and (4) removing the dried fibrous web from the traveling foraminous belt. Surprisingly, the towel of the present invention possesses high levels of absorbent capacity, absorbent rate, strength. and softness. More particularly, the towel of the present invention has an absorbent capacity of at least about 385%, an absorbent rate of about 8 seconds or less, a dry tensile strength of at least about 5700 grams to about 11,000 grams, and a wet tensile strength of at least about 1200 grams to about 1500 grams.

Even more particularly, the towel of the present invention is prepared by a process wherein the cellulosic fibers in the furnish comprise secondary cellulosic fibers. The high levels of absorbent capacity, absorbent rate, strength, and softness are also achieved using the secondary cellulosic fibers. This aspect of the present invention is particularly advantageous because the cost of secondary cellulosic fibers is substantially less than the cost of virgin cellulosic fibers.

Still more particularly, the towel of the present invention is prepared by a process further comprising the step of embossing the dried fibrous web after removing the dried fibrous web from the traveling foraminous belt. The embossing increases the absorbent capacity, absorbent rate, and softness of the web, but tends to reduce the strength of the web. Towels of the present invention prepared by the process including the embossing step have an absorbent capacity of at least about 400%, an absorbent rate of at least about 6 seconds or less, a tensile strength of at least about 1800 grams to about 2700 grams, and a wet tensile strength of at least about 380 grams to about 680 grams.

Still more particularly, the towel of the present invention is prepared by a process which includes the steps of: (1) forming a furnish of cellulosic fibers, water, and a chemical debonder; (2) depositing the furnish on a first traveling foraminous belt, thereby forming a fibrous web on top of the first foraminous belt; (3) transferring the fibrous web from the first traveling foraminous belt to a second foraminous belt traveling at a velocity from about 5 to 10% slower than the velocity of the first foraminous belt, thereby providing a series of transverse folds in the fibrous web; (4) subjecting the fibrous web to non-compressive drying to remove water from the fibrous web; and (5) removing the dried fibrous web from the second traveling foraminous belt. The towel made from this particular process exhibits even greater levels of strength and softness because of the series of folds in the towels. The folds increase the strength of the towels by providing a degree of stretch, thereby reducing the tendency of the towel to tear when subjected to stress. The folds in the towels increase the softness of the towels by increasing the thickness of the towel.

This invention, therefore, provides a more absorbent hand or wiper towel and a process for its manufacture.

Other objects, features, and advantages will become apparent from reading the following specifications in conjunction with the accompanying drawings.

Fig. 1 is a perspective view of the process line for producing a preferred embodiment of the present invention; and

Fig. 2 is an enlarged sectional view of the point of transfer between the forming belt and the through dryer belt in a process line for producing another preferred embodiment of the present invention.

Turning first to Fig. 1, there is illustrated a process line 10 for producing a preferred embodiment of the present invention. The process line begins with a paper-making furnish 12 comprising a mixture of secondary cellulosic fiber, water, and a chemical debonder which is deposited from a conventional head box (not shown) through a nozzle 14 on top of a foraminous wire forming belt 16 as shown in Fig. 1. The forming belt 16 travels around a path defined by a series of guide rollers. The forming belt 16 travels from an upper guide roller 20, positioned below and proximate to the head box nozzle 14, horizontally and away from the head box nozzle to another upper guide roller 22, passes over the upper guide roller 22 and diagonally and downwardly to a lower guide roller 24, passes under the lower guide roller 24 and diagonally and upwardly toward the nozzle 14 to a lower guide roller 26, passes over lower guide roller 26 and diagonally and downwardly to lower guide roller 28, passes under lower guide roller 28, and turns upwardly and slightly inwardly to a guide roller 32, passes behind the guide roller 32 and upwardly and outwardly returns to upper guide roller 20.

A vacuum forming box 34 positioned beneath the forming belt 16 proximate the opening 36 of the head box nozzle 14 immediately extracts water from the moist fibrous web 38 deposited on top of the forming belt by the head box nozzle. The partially dewatered fibrous web 38 is carried by the forming belt 16 in the counterclockwise direction, as shown in Fig. 1, towards the upper guide roller 22. The fibrous web 38 as it moves away from the vacuum forming box 34 preferably comprises from about 19% to about 30% cellulosic fiber by weight. An edge vacuum 40 positioned below the forming belt 16 proximate to the upper guide roller 22 is an aid to trimming the edges of the fibrous web 38.

The fibrous web 38 passes over the upper guide roller 22 and downwardly between the forming belt 16 and a through-dryer belt 42.

The through-dryer belt 42 travels around a path defined by a series of guide rollers. The through-dryer belt 42 travels from a guide roller 44 positioned above and vertically offset from guide roller 22 downwardly towards the forming belt 16, contacts the fibrous web 38, and then downwardly and diagonally away from guide roller 24 to guide roller 46, passes under guide roller 46 and turns horizontally away from the forming belt 16 towards a through-dryer guide roller 48, passes under the through-dryer guide roller 48 and turns upwardly and over a through-dryer 50 and downwardly to another through-dryer guide roller 55, passes under through-dryer guide roller 55 and turns horizontally away from the through-dryer 50 towards a lower guide roller 54, passes under lower guide roller 54, and turns upwardly to an upper guide roller 56, passes over the upper guide roller 56 and turns slightly downwardly to an upper guide roller 58, passes under the upper guide roller 58, and turns slightly upwardly in the direction of the forming belt 16 to an upper guide roller 60, passes over upper guide roller 60 and turns downwardly to a guide roller 62, passes under guide roller 62 and turns substantially horizontally away from forming belt 16 to a guide roller 62, passes around guide roller 64 and turns horizontally in the direction of the forming belt 16 and returns to guide roller 44.

A vacuum pickup 66 pulls the fibrous web 38 towards the through-dryer belt 42 and away from forming belt 16 as the fibrous web passes between the through-dryer belt and the forming belt. The fibrous web 38 adheres to the through-dryer belt 42 and is carried by the through-dryer belt downwardly below lower guide roller 46 towards the through-dryer 50. Vacuum boxes 68 positioned above and proximate to the through-dryer belt 42 between the lower guide roller 46 and the through-dryer guide roller 48 further extract water from the moist fibrous web 38. The fibrous web 38 preferably comprises between about 25% and 35% fiber by weight after passing beneath the vacuum boxes 68.

The through-dryer 50 generally comprises an outer rotatable perforated cylinder 51 and an outer hood 52 for receiving the hot air blown through the perforations 53, the fibrous web 38, and the through-dryer belt 42 as is known to those skilled in the art. The through-dryer belt 42 carries the fibrous web 38 over the upper portion of the through-dryer outer cylinder 50. The heated air forced through the perforations 53 in the outer cylinder 51 of the through-dryer 50, removes the remaining water from the fibrous web 38. The temperature of the air forced through the fibrous web 38 by the through-dryer is preferably about 149° C to 177° C, (300 to 350° F.)

The through-dryer belt 42 carries the dried fibrous web 38 below the through-dryer guide roller 55 towards the lower guide roller 54. The dried fibrous web 38 is pulled from the through-dryer belt at lower guide roller 54 by a takeup roller 70. The dried fibrous web 38 passes from the through-dryer belt 42 to a nip between a pair of embossing rollers 72. The dried and embossed fibrous web 38 then passes from the nip between the embossing rollers 72 to the takeup roller 70 where the fibrous web is wound into a product roll 74.

In an even more preferred embodiment of the present invention, the process line 10 previously described is modified so that the through-dryer belt 42 travels at a velocity from about 5 to 10% slower than the velocity of the forming belt 16. As a result, the moist fibrous web 38 arrives at the point of transfer 76 between the forming belt 16 and the through-dryer belt 42 at a faster rate than the fibrous web is carried away by the through-dryer belt. As the moist fibrous web 38 builds up at the point of transfer 76, the moist fabric tends to bend into a series of transverse folds 78 as shown in Fig. 2. The folds provide for a degree of stretch in the fibrous web thereby increasing the overall strength of the fibrous web, and because the folds stack on top of one another, the fibrous web becomes thicker and thus softer.

This invention is further illustrated by the following example which is illustrative of a preferred embodiment designed to teach those of ordinary skill in the art how to practice this invention.

EXAMPLE 1

An initial paper-making furnish is prepared comprising 0.15% by weight of secondary cellulosic fiber and 99.85% water. The secondary cellulosic fiber used in the furnish comprises a mixture of 80% cup stock fiber and 20% deinked wastepaper. 20 wet lbs. (Please see conversion table, attached.) of Berocel 584 debonder, a surfactant manufactured by Berolchemie AG, per ton of dry secondary cellulosic fiber is added to the initial furnish mixture. 11.4 dry lbs. (Please see conversion table, attached.) of Kymene 557-H wet strength resin, a polyamide epichlorohydrin resin manufactured by Hercules and 500 ml. of Sterox DF, a rewetting agent manufactured by Monsanto, are also added to each dry ton of the initial furnish resulting in a furnish with a Canadian Standard Freeness of 410 cc.

The final furnish is deposited from a head box through a 1/4 in. (Please see conversion table, attached.) width opening onto a 94 M Appleton forming web, manufactured by Appleton Wire. The forming belt travels at a velocity of 40 ft. (Please see conversion table, attached.) per minute. The deposited furnish forms a web of cellulosic fibers with a dry basis weight of 46 grams per sq. meter on top of the forming belt.

Immediately after the fibrous web is formed on top of the forming belt, the fibrous web passes over a forming box vacuum which operates at a pressure of 8 in. Hg (Please see conversion table, attached.) below atmospheric pressure and extracts water from the fibrous web. The fibrous web then passes over an edge vacuum which operates at a vacuum of 11-15 in. Hg (Please see conversion table, attached.) below atmospheric pressure and further trims the edges of the fibrous web.

The fibrous web is then transferred to a 31 A Albany through-dryer belt, manufactured by Albany

International, with the aid of a vacuum pickup which produces a vacuum of 11-15 in. Hg (Please see conversion table, attached.) below atmospheric pressure. The through-dryer belt also travels at a velocity of 40 ft. per minute. The consistency of the partially dewatered fibrous web after the transfer to the through-dryer belt contains 19% by weight of dry cellulosic fiber.

The through-dryer belt carries the partially dewatered fibrous web over a pair of vacuum boxes each producing a vacuum of 14 in. Hg (Please see conversion table, attached.) below atmospheric pressure and further dewaters the fibrous web. The through-dryer belt then carries the fibrous web around the upper portion of a cylindrical through-dryer. The fibrous web prior to transfer to the through-dryer comprises 26% to 27% by weight of cellulosic fiber. The through-dryer forces air at a temperature of 335° F (Please see conversion table, attached.) through the fibrous web and removes the remaining water from the fibrous web. The dried fibrous web is pulled directly from the through-dryer belt for use as a hand or wiper towel.

A towel produced according to the specifications in Example 1 was subjected to a series of tests to determine the absorbency and strength of the towel and is indicated in Table 1 as Example 1 base towel. The base towel from Example 1 was also subjected to post-treatment embossing followed by the same series of tests. A portion of the Example 1 base towel was embossed with Kimberly Clark Embossing Pattern 1 (Northern Engraving Pattern No. 1804) and another portion of the Example 1 base towel was embossed with Kimberly Clark Pattern 2 (Northern Engraving Pattern No. 1557). The results of tests performed on the embossed towels is also shown in Table 1. Three prior art hand or wiper towels the Scott 180, the Fort Howard 202, and the Crown Zellerbach 820, were also subjected to the same tests as the Example 1 base towel. The results of the tests performed on the prior art towels are also shown in Table 1 for comparative purposes.

The basis weight of the towels shown in Table 1 was determined according to ASTM D3776-9 and is shown in units of pounds (Please see conversion table, attached.) of dry towel per 2,880 sq. ft. (Please see conversion table, attached.) of towel. The water capacity of the towels in Table 1 was measured according to federal specification UU T-595C and is shown as the percent of the weight of the towel which the towel can absorb in weight of water. The water rate of the towels in Table 1 was measured according to TAPPI (Technical Association of the Pulp and Paper Industry) T432 SU-72. The water rate is shown in Table 1 as the number of seconds for a 4" (Please see conversion table, attached.) x 4" (Please see conversion table, attached.) towel to become saturated with water. The thickness of the towel is measured according to TAPPI T411-68 and is shown in inches in Table 1. The tensile strengths of the towels shown in Table 1 are measured according to ASTM D1117-6 and D1682. The tensile strength is the amount of stress required to pull a 3-in. (Please see conversion table, attached.) length of towel apart. The tensile strengths shown in Table 1 are expressed in grams. The tensile strengths of dry towels were measured in both the machine direction and the cross direction. The tensile strengths of the towels saturated with water were measured in the cross direction.

TABLE 1

	Scott 180	Fort Howard 202	Crown Zellerbach 820	Example Base Towel	Embossed Base Towel K-C Pat. 1	Embossed Base Towel K-C Pat. 2
Basis Weight, #/2880ft2 *	27	27	25	27	27	27
Absorbant Capacity, %	284	270	295	385	399	505
Absorbant Rate, Seconds	35	58	69	8	6	4
Thickness, Inches *	0.0042	0.0043	0.0046	0.0077	0.0083	0.0093
Tensile Strength						
MD Dry, g	7480	6690	6690	10890	6078	2679
CD Dry g	3460	3470	2640	5738	2421	1889
CD Wet g	1163	750	800	1481	673	387

*Please see conversion Table, attached.

As shown in Table 1, the Example 1 base towel possesses a superior absorbent capacity to other hand or wiper towels which comprise the same or about the same basis weight as the Example 1 base towel. The absorbent capacity of the Example 1 base towel as shown in Table 1 is 90% greater than any of the prior art towels also shown. The Example 1 base towel also possesses a superior level of absorbent rate than the prior art towels shown therein. The absorbent rate of the Example 1 base towel is at least 4 times faster than any of the prior art towels shown in Table 1. The Example 1 base towel also possesses a greater thickness than those prior art towels shown in Table 1 and thus is a softer towel. Further, the tensile strength of the Example 1 base towel is superior to the tensile strengths of the prior art towels shown in Table 1.

The embossed Example 1 base towels possess even higher levels of absorbent capacity and absorbent rate as shown in Table 1. The tensile strengths of the embossed Example 1 base towels are reduced somewhat by the embossing but remain comparable to the tensile strengths of the prior art towels shown in Table 1.

In summary, the data in Table 1 show that hand or wiper towels which are preferred embodiments of the present invention possess superior levels of absorbent capacity, absorbent rate, softness and strength to other prior art hand or wiper towels of the same or about the same basis weight.

It should be understood that the foregoing relates only to preferred embodiments of the present invention, and that numerous changes and modifications may be made without departing from the spirit and scope of the invention as defined in the following claims.

Claims

1. A towel prepared by a process comprising the steps of:
forming a furnish of cellulosic fibers, water, and a chemical debonder;
depositing the furnish on a traveling foraminous belt thereby forming a fibrous web on top of the traveling foraminous belt ;
subjecting the fibrous web to non-compressive drying to remove the water from the fibrous web; and
removing the dried fibrous web from the traveling foraminous belt.

2. The towel prepared by a process as in claim 1, wherein:
the towel has an absorbent capacity of at least about 385%, an absorbent rate of about 8 seconds or less, a dry tensile strength of at least about 5700 grams to about 11,000 grams, and a wet tensile strength of at least about 1200 grams to about 1500 grams.

3. The towel prepared by a process as in claim 1 or 2, further comprising the step of:
embossing the dried fibrous web after removing the dried fibrous web from the traveling foraminous belt.

4. The towel prepared by a process as in one of the preceding claims, wherein:
the cellulosic fibers in the furnish comprise secondary cellulosic fibers.

5. The towel prepared by a process as in one of the preceding claims, wherein:
the non-compressive drying is achieved with a through-dryer.

6. The towel prepared by a process as in claims 3 to 5, wherein:
the towel has an absorbent capacity of at least about 400%, an absorbent rate of about 6 seconds or less, a dry tensile strength of at least about 1800 grams to about 2700 grams, and a wet tensile strength of at least about 380 grams to about 680 grams.

7. A towel prepared by a process comprising the steps of:
forming a furnish of cellulosic fibers, water, and a chemical debonder;
depositing the furnish on a first foraminous belt, the first foraminous belt traveling at a first velocity, thereby forming a fibrous web on top of the first foraminous belt ;
transferring the fibrous web from the first traveling foraminous belt to a second foraminous belt , the second foraminous belt traveling at a second velocity from about 5% to about 10% slower than the first velocity, thereby providing a series of transverse folds in the fibrous web;
subjecting the fibrous web to non-compressive drying to remove the water from the fibrous web; and
removing the dried fibrous web from the second traveling foraminous belt.

8. The towel prepared by a process as in claim 7, wherein:
the cellulosic fibers in the furnish comprise secondary cellulosic fibers.

9. The towel prepared by a process as in claim 8, wherein:
the non-compressive drying is achieved with a through-dryer.

10. The towel prepared by a process as in claim 9, further comprising the step of: embossing the dried fibrous web after removing the dried fibrous web from the second traveling foraminous belt .

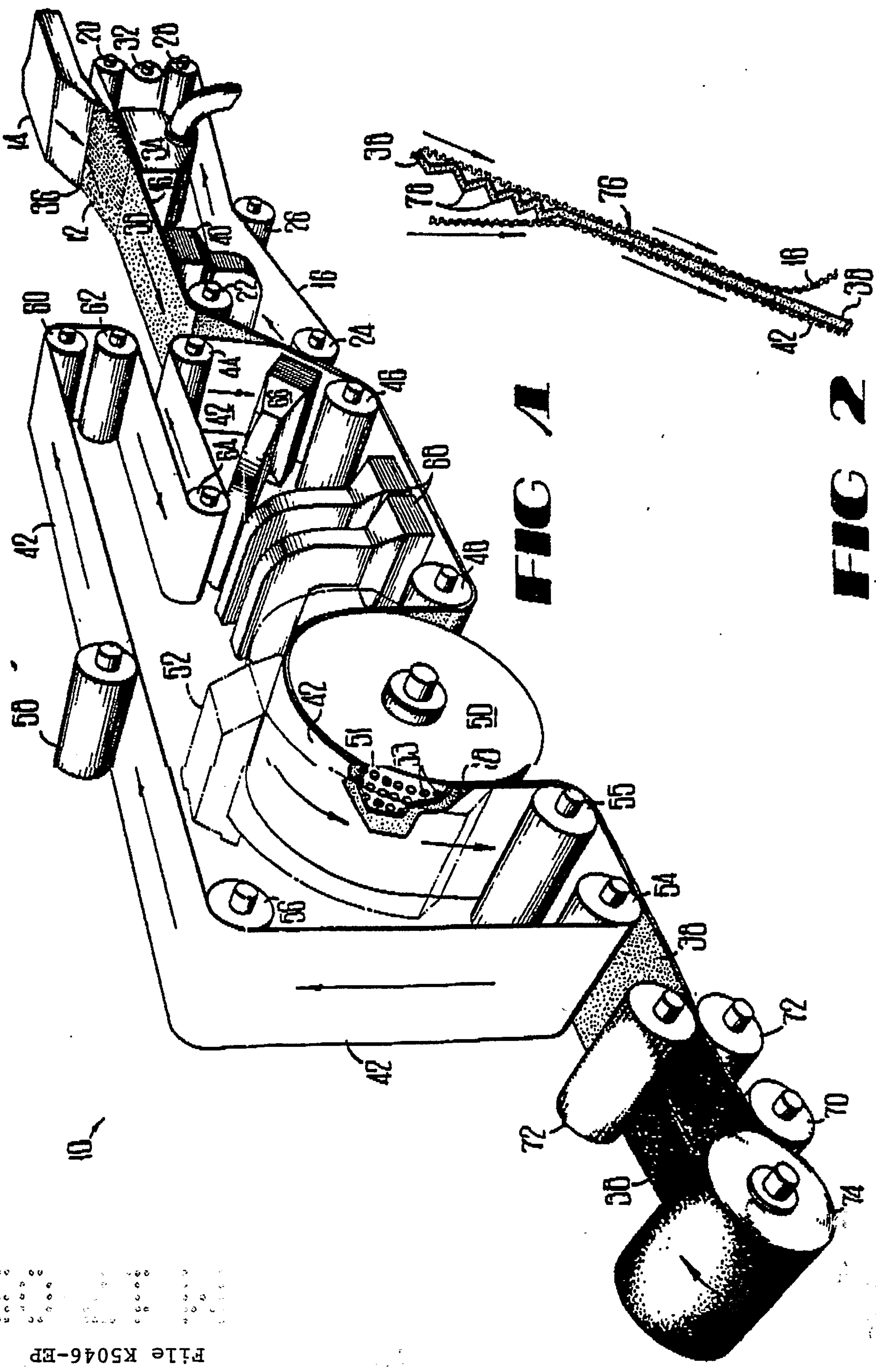
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FIG 1

FIG 2