United States Patent

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[54] **APPARATUS FOR USE ON PAPERMAKING MACHINES**
7 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **139/383,** 139/420
[51] **Int. Cl.** **D03d 1/00**
[50] **Field of Search** ..... 162/358, 360; 139/383, 383 A, 420, 425; 34/95, 151; 161/62, 1, 64

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ABSTRACT: This invention relates to an improved papermakers' fabric for use in the press section of a papermaking machine and more specifically to a papermakers' fabric having a plurality of spaced, parallel, substantially incompressible grooves in at least one surface thereof, which provide void volume for water expressed from a paper web as it passes through the pressure nip of the press rolls in the machine.

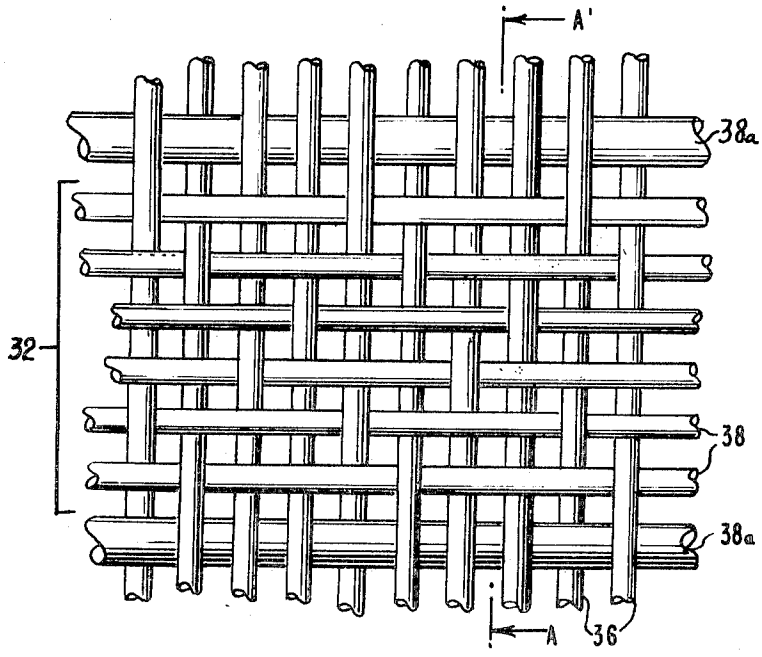


Fig. 1

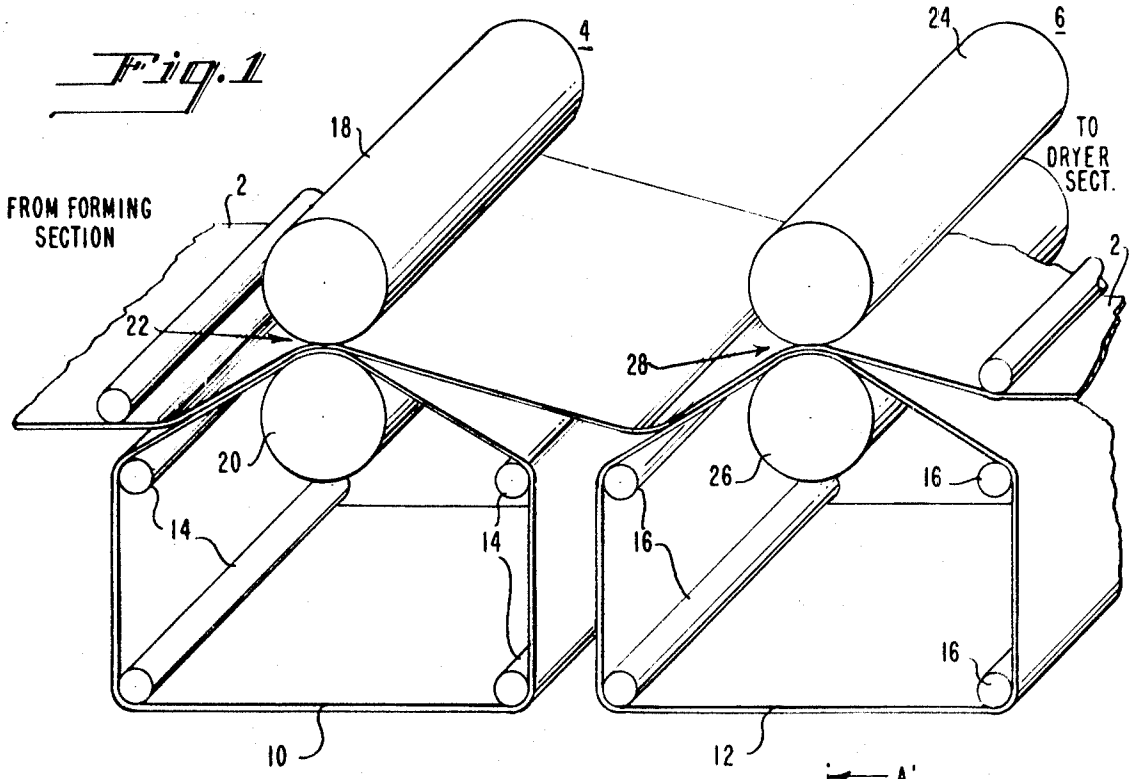


Fig. 2

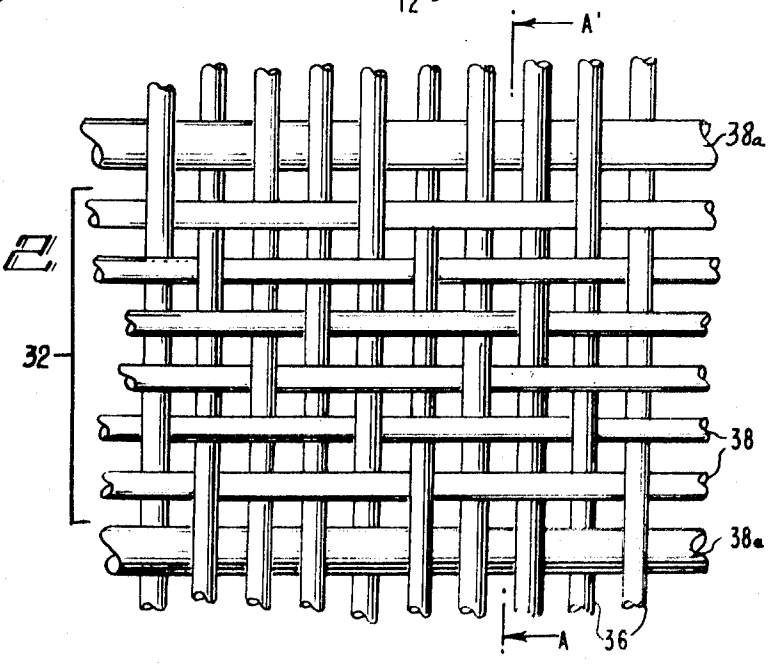
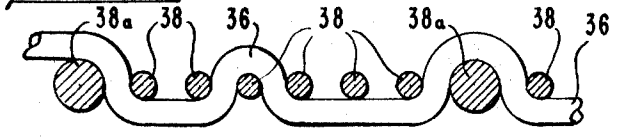


Fig. 3



ATTORNEY

APPARATUS FOR USE ON PAPERMAKING MACHINES

BACKGROUND OF THE INVENTION

In the typical papermaking machine such as the so-called fourdrinier machine, an aqueous suspension of fibers, called the "furnish," is flowed onto a travelling forming medium, generally an endless woven belt of wire and/or synthetic material, to form a continuous sheet of paper or paperlike material. In this connection, the term paper or paperlike material is used in a broad or generic sense and is intended to include such items as paper, board, pulp, asbestos-sheet and other similar structures. As the "furnish" travels on the forming medium, much of the water is removed therefrom and a somewhat self-supporting continuous web is formed, this water removal being facilitated by the use of such well-known devices as hydrofoils, table rolls and/or suction boxes.

After leaving the forming medium, the somewhat self-supporting paper web is transferred to a press section in the machine, where still more of its water content is removed by passing it through a series of pressure nips formed by cooperating press rolls, these press rolls also serving to compact the web as well. Subsequently, the paper web is transferred to a dryer section where it is passed about and held in heat transfer relation with a series of heated generally cylindrical rolls to remove still further amounts of water therefrom.

In the press section of the machine, it is advantageous to remove as much water as possible from the paper web without causing any damage thereto, such as by crushing. Crushing occurs when an excessive amount of water is removed from the paper web which cannot be carried through the press nip, the excessive water then accumulating at the ingoing side of the nip and moving in a direction counter to that of the moving web. Accordingly, care should be taken to ensure that there is sufficient void volume present in the area of the press nip (either in the fabric or in the press rolls) such that as the paper web undergoes compression, all of the water expressed therefrom will be carried through the nip.

conventionally the paper web is carried through the pressure nips in the press section by means of an endless band of woven, felted material commonly known as a papermarkers' press felt. Where "plain" press rolls are used, the necessary void volume for the water expressed from the paper web as it undergoes compression in the press nip usually is provided solely by press felts and/or supplementary backing fabrics or belts therefor. However, where suction or grooved press rolls are used, void volume is also supplied by perforations or grooves in the roll surfaces or coverings. In the suction press arrangement, suction means are required for holding the expressed water in the roll perforations, not only while the paper web passes through the press nip, but also for a short time thereafter in order to prevent rewetting of the paper web by water which may become dislodged from the perforations due to the centrifugal forces created by the rotating rolls and possibly enhanced by the capillary action on the water by the felt or paper. In the grooved press, one or more press rolls are made with circumferential grooves in the roll face to accommodate water expressed from the web.

As the trend in the paper industry today is toward higher machine speeds, greater amounts of void volume must be provided in the felts or in the machine rolls in order to remove maximum amounts of water from the paper web. Where such void volume is not provided, the machine will be unnecessarily limited in its operating speed, hence lowering the amount of paper which may be produced thereon. Since the suction press arrangement not only requires perforations in the press roll surfaces, but also suction devices which must be applied thereto in a sealtight arrangement, it is generally desired, from an economical standpoint, to utilize a "plain" press arrangement, provided that the water expressed from the paper web in the press nips can be adequately carried therethrough without crushing the paper web. Further, and due to the fact

that greater amounts of suction must be applied to the perforations during high-speed operation of the machine in order to retain the water therein (this being due to the increased centrifugal forces created by the rolls rotating at faster speeds), there may be a tendency for the suction rolls to apply pressure unevenly to the paper web, the result being an uneven or nonuniform dewatering of the web and possible shell-marking thereof.

Similarly, a plain press is often preferred to a grooved press because the grooves tend to derogate the fabric thereby decreasing its life, and may tend to mark the sheet, in part because when used with regular fabrics the latter may tend to press into the roll grooves.

In the press arrangements heretofore discussed, and particularly in a "plain" press arrangement, the press felt may be backed by a perforated mat which is disposed between the felt and the lower press roll and which travels though the nip of the press roll together with the felt and paper web in order to provide additional void volume for water expressed from the web. Recent technical advances in the papermaking field have shown that duplex fabrics not only are desirable for use as press felts, but also as backing fabrics. When used as a felt, one layer of the duplex fabric (the top layer) is made relatively soft or compressible so as not to mar the surface of the paper web with which it comes into contact and the other layer (the bottom layer) is made relatively hard and substantially incompressible in order to provide the necessary void volume for the expressed water. While either of the above-mentioned arrangements provide generally satisfactory water removal for machines operating at present-day speeds, the felt-mat arrangement requires a separate group of roll structures on which to run on the machine while duplex felts are multiply structures in which two separately woven fabrics are stitched together, or are integrally woven at the same time into a unitary structure, duplex felts of both designs being both difficult and costly to weave endless.

Therefore, one object of this invention is to provide an improved papermakers' fabric for use in the press section of the papermaking machine.

Another object of this invention is to provide an improved papermakers' felt having increased void volume.

Another object of this invention is to provide an improved dewatering arrangement in the press section of a papermaking machine wherein relatively large quantities of water may be removed from a paper web without crushing or marring the surface thereof.

STill another object of this invention is to provide means for increasing the amount of water removed from a paper web in the press section of a papermaking machine.

A further object of this invention is to provide an improved press felt for use in a plain press arrangement of a papermaking machine.

A further object of this invention is to provide an improved backing fabric for a press felt in a papermaking machine.

Another object of this invention to provide an improved papermakers' felt less likely to deflect into the grooves in a grooved press roll.

SUMMARY OF THE INVENTION

A preferred embodiment of this invention includes a papermakers' fabric having interwoven yarns wherein selected of the fabric yarns will be made of a material which is substantially incompressible; that is, will not deform substantially when passed through the pressure nips of the press section. The selected yarns will also be made greater in size than the nonselected yarns. By constructing a fabric to have such yarns selectively spaced therein, there is provided in the fabric a plurality of substantially incompressible parallel grooves which are disposed between adjacent of the selected yarns and which provide increased void volume for water expressed from the paper web as it passes through the pressure nips in the press section. Such a fabric is particularly adapted for use in a plain

press arrangement since felt void volume is of particular importance therein; however, such a fabric may also be desired for use in either a suction or grooved press.

Additional objects and advantages of this invention together with a better understanding thereof may be had by referring to the following detailed description together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a cabinet view of a simplified press section of a papermaking machine in which this invention may be incorporated;

FIG. 2 shows a schematic view of a preferred embodiment of the improved papermakers' felt of this invention; and

FIG. 3 shows a cross section view of the improved papermakers' fabric shown in FIGS. 1 and 2 and is taken along the lines A—A' of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to FIG. 1, there is shown a press section of a papermaking machine in which a continuous paper web 2 is shown as travelling from left to right as viewed in the drawing. The paper web 2 is received from the forming section of the machine (not shown) and at this point in its formation, it is to some extent self-supporting. In the simplified section shown in FIG. 1, two sets of press rolls 4 and 6 are disclosed and the paper web 2 is shown as passing through the nip of each in order to remove water therefrom. However, a greater or lesser number of press rolls, and thus pressure nips, may be used and in fact, such may be required or necessitated due to the nature of the web being produced on the machine. After leaving the press section of the machine, the paper web 2 is transferred to a dryer section of the machine (also not shown) where still further amounts of water will be removes therefrom, as by evaporation.

As the paper web 2 passes through the nip of the first set of press rolls 4, it is guided or carried on its passage by means of a first papermakers' fabric 10. As previously mentioned, and as will be used hereinafter, such papermakers' fabrics are commonly referred to as press felts. The first press felt 10 may be an endless or joined fabric having a structure which will be explained in greater detail hereinafter; however, for the present, it need only be said that the felt 10 travels about a plurality of rolls 14, one or more of which may be a felt roll, guide roll, or stretch roll, which define in part its path of travel and which maintain appropriate tension thereon to ensure its proper operation on the machine.

Also included in the arrangement shown in FIG. 1 is a second press felt 12 which is used for guiding or carrying the paper web 2 through the nip of the second set of press rolls 6. The second press felt 12 may be identical to the first press felt 10, but preferably will be of a slightly different construction commensurate with higher nip loading in the second press in order to enhance water removal. For example, since less water is removed in the second press, the fabric grooves of the present invention would not have to be as large in a fabric used in the second press as in one used in the first press, so the width span of each groove can be less, thereby permitting higher nip pressures on the fabric as it passes through the second press. The second press felt 12 travels about a plurality of rolls 16 one or more or which may be a felt roll, guide roll, or stretch roll, which also define in part its path of travel as well as maintain appropriate tension thereon to ensure proper operation on the machine.

The first set of press rolls 4 includes an upper end generally cylindrical roll 18 and a lower generally cylindrical roll 20 which are disposed closely adjacent one another to form a pressure nip 22 through which the press felt 10 and the paper web 2 pass to remove water from the web. In many instances, it is desirable to provide one of the press rolls (preferably the upper roll) with a slight crown or a bow in the center thereof to ensure that the paper web 2 receives uniform pressure on all portions thereof as it passes through the pressure nip 22. In this instance, the press rolls are of a "plain" construction, that is, they have smooth generally imperforate surfaces which contact the paper web and/or press felt. However, it should also be recognized that the improved felt of this invention can also be used in suction or grooved press roll arrangements.

In a similar, if not identical, manner the second set of press rolls 6 includes an upper generally cylindrical roll 24 and a lower generally cylindrical roll 26, again both of which are preferably of a "plain" construction. The upper 24 and lower 26 press rolls are disposed closely adjacent one another to form a pressure nip 28 through which the press felt 12 and the paper web 2 pass in order that additional amounts of water will be removed from the paper web 2. Again, it is generally desirable to provide the upper press roll 24 with a slight crown in the center thereof to ensure that the paper web 2 receives uniform pressure thereon as it passes through the nip 28.

As previously mentioned, when a plain press roll arrangement is utilized, the water expressed from the paper web as it passes through the nip of the press must be carried through the press nip by the void volume in the felts in order to preclude the possibility that the water will travel along the surface of the press roll in a direction opposite to that in which the press rolls and paper web are travelling and produce destruction of the paper web due to a phenomenon commonly referred to as crushing. Thus, it is highly desirable, if not mandatory, for the press felts to be constructed to accommodate large amounts of void volume in order to ensure that all of the water expressed from the paper web will be carried through the press nip. Otherwise, high-speed operation of the machine will not be possible.

Turning now to FIGS. 2 and 3, there is shown a detailed description of a press felt for accomplishing the above-mentioned objectives. For purposes of this discussion, only the first press felt 10 will be discussed in detail; however, it should be noted that the second press felt 12 may be constructed identical therewith but preferably will be of a slightly different construction to accommodate different press nip conditions. Accordingly, the first press felt 10 comprises a woven fabric having machine direction yarns 36 (those yarns which extend in the direction of travel of the felt) and cross-machine direction yarns 38 (those yarns which extend in a direction transverse to the direction of travel of fabric). The yarns 36 and 38 are selectively chosen such that the woven fabric will have a plurality of substantially incompressible grooves 32 therein. By substantially incompressible, it is meant that as the fabric passes through the pressure nip of the press rolls, the grooves will not be substantially deformed. Thus, water expressed from the paper web 2 into these grooves 32 can remain in the grooves as the felt passes through the press nip so that the water will not cause possible crushing of the paper web 2.

According to the principles of this invention, selected of the fabric yarns are characterized by being substantially incompressible and larger in size than the remainder or nonselected yarns in the fabric. In the preferred embodiment, selected 38*a* of the cross-machine direction yarns will be made substantially incompressible and larger in size than the remainder or nonselected cross-machine direction yarns and all of the machine direction yarns 36, the result being that the areas between adjacent selected yarns become grooves 32 in the felt. In order to prevent marking of the paper web 2, the oversized cross-machine direction yarns 38*a* are woven in such a manner that the side of the felt which is to contact the paper web is relatively smooth in spite of the nature of the selected yarns. Accordingly, the oversized yarns 38*a* in the press felt are shown as being woven in a modified crowfoot satin weave pattern with the coarse yarns woven as a warp effect crowfoot satin, and the fine yarns that are lying parallel to the coarse yarns woven as a filling effect crowfoot satin weave. The fabric just described pertains to a joined fabric in which the yarns 38 and 38*a* are in the cross-machine direction. If woven endless, the description of the weave would change ac-

cordingly. However, other suitable weave patterns can be used where, due to the nature of the woven fabric and the type of web to be formed thereon, the oversized yarns may be more desirably woven in another pattern. Thus, the grooves are effectively formed on the nonpaper-contacting side of the fabric.

The press felt **10** is shown as being of a four-harness modified satin weave pattern; however, it is not the intention of this invention to be limited to such a patter, as examples of other suitable basic weaves include, but are not limited to, twill weaves, five- or six-harness satin weaves and basket weaves. As is well known in the textile art, twill, satin, and basket weaves are basic weaves from which are commonly constructed more complex duplex weaves, warp back weaves, and filling back weaves which, it will be obvious, are suitable for use in the practice of this invention. Such complex weaves are referred to herein as "reinforced" weaves.

Preferably, the press felt **10** will be woven of natural fibers such as wool or cotton, of synthetic fibers such as polyamides, polyolefins, polyacrylics or polyesters, or of suitable combinations or blends thereof. However, it can be seen that the final selection of the fibers which will be used in the felt as well as the weave pattern thereof in most instances will be determined by the nature of the web to be formed, the required finish thereon, the amount of drainage required and the ultimate strength thereof, and/or to make the fabric more or less wetable to enhance the performance of the fabric on the papermaking machine.

When the felt **10** is placed on a papermaking machine, the water expressed from the paper web **2** as it passes through the press roll nip **22** will accumulate in the grooves **32** of the felt. Since the selected cross-machine direction yarns are substantially incompressible, even under the nip pressure, the grooves **32** will likewise be substantially incompressible and the water will be carried through the press nip to the other side thereof where it may be purged from the fabric either by centrifugal forces created on the fabric as it passes over the rolls and changes direction or by special well-known purging means such as superatmospheric air or suction devices.

While any number of oversized substantially incompressible yarns may be utilized, it should be noted that an excessive number should not be used as this will tend to reduce the amount of void volume present in the felt whereas an insufficient number will provide oversized grooves which may be incapable of maintaining large quantities of water therein as the felt passes through the press roll nip. Thus, the specific construction of the felt **10** of this invention will generally be determined by the ultimate use to which the felt is to be put and the type of web to be transported thereon. Therefore, it is not the intention of this invention to be limited to a specific arrangement such as has hereinbefore been described. However, one such felt may be constructed in which the warp yarns **36** and the nonselected weft yarns are made from natural fibers such as cotton, wool or of synthetic fibers such as nylon or polyester while the selected oversized, substantially incompressible yarns **38***a* are made from synthetic material such as nylon.

In the operation of this invention, the felt **10** is used to guide the paper web **2** through the pressure nip of the first set of press rolls **4**. As the paper web **2** and the press felt **10** pass through the pressure nip **22**, water is squeezed out of the paper web and into the felt **10**. Since selected of the felt yarns are substantially incompressible, thus making the volume between the selected yarns likewise incompressible, the water expressed from the paper web resides in the grooves. When the felt leaves the area of the pressure nips, the water in its grooves may be removed either by subjecting the felt to centrifugal forces great enough to throw the water therefrom or by subjecting the felt to conventional air purging or suction devices. By having the selected yarns extend in the cross-machine direction, the yarns further ensure that crushing of the web does not occur by acting as barriers or dams which convey the water through the pressure nip.

However, the selected yarns may instead extend in the machine direction if such is desired.

Where desired, a felt as constructed in accordance with this invention may also be used as a supplementary or backing belt in the press section of the machine rather than as a felt having a surface in contact with the paper web. In such an arrangement, a conventional woven or needled felt may be used to contact and guide the paper web through the press nip with the fabric of this invention being interposed between the felt and the lower press roll. When such an arrangement is utilized, a softer, more cushiony felt can be used for contacting the paper web, thus permitting the production of finer grades of paper products thereon. Further, this type of an arrangement permits still higher operating speeds of the machine as the interposed felt will provide void volume in addition to that provided by the backing fabric.

From the above discussion, it can be seen that a papermakers' fabric, and specifically a press felt, which is constructed in accordance with the principles of this invention will provide large amounts of void volume for water expressed from the paper web in the area of the press nip so as to improve the water removal therefrom and prevent crushing of the paper web. Further, such a fabric may be constructed in a manner as to minimize possible marking of the paper web while also increasing the amount of water which may be removed therefrom.

It will also be noted that the relatively stiff and incompressible characteristics of the selected yarns will tend to inhibit the fabric from deflecting into the grooves of a grooved press roll when used in conjunction therewith.

While I have shown and described only particular embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made thereto without departing therefrom in its broader aspects. Therefore, it is the intention of the appended claims to cover all changes and modifications as fall within the true spirit and scope of this invention.

What we claim as new and novel and desire to secure by Letters Patent of the United States is:

1. A papermakers' fabric for use in the press section of a papermaking machine comprising interwoven machine direction and cross-machine direction yarns, said machine direction yarns extending in the direction of travel of said fabric and said cross-machine direction yarns extending in the direction transverse to the direction of travel of said fabric, selected of said fabric yarns being substantially incompressible and larger in size than the remainder of the yarns which extend in the same direction to form an array of parallel substantially incompressible grooves between adjacent of said selected yarns.

2. A papermakers' fabric as described in claim **1** wherein said selected yarns extend in the cross-machine direction of said fabric.

3. A papermakers' fabric as described in claim **1** wherein said selected yarns extend in the machine direction of said fabric.

4. A papermakers' fabric as described in claim **1** wherein said yarns are interwoven in a modified satin weave pattern.

5. A papermakers' fabric as described in claim **1** wherein said yarns are interwoven in a reinforced weave.

6. A papermakers' fabric as described in claim **1** wherein said selected yarns are made from synthetic materials.

7. A press felt for use in the press section of a papermaking machine comprising a woven fabric having machine direction yarns which extend in the direction of travel of said fabric and cross-machine direction yarns extending in a direction transverse to the direction of travel of said fabric, said yarns being interwoven in a modified satin weave pattern, selected of said cross-machine direction yarns being substantially incompressible and larger in size than the remainder of the yarns which extend in the cross-machine direction to form an array of substantially incompressible grooves adjacent of selected yarns, said selected yarns being made from a synthetic material.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,603,354 Dated September 7, 1971

Inventor(s) Charles Allen Lee, et. al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet [73] "New Huyck Corporation" should read -- Huyck Corporation -- . Column 1, line 41, "conventionally" should read -- Conventionally -- . Column 2, line 33, "multiply" should read -- multi-ply -- ; line 53, "of" should read -- in -- ; line 57, after "invention" insert -- is -- . Column 3, line 26, after "simplified", insert -- press -- ; line 36, "removes" should read -- removed -- . Column 5, line 9, "patter" should read -- pattern -- . Claim 7, line 73, after "grooves", insert -- between -- .

Signed and sealed this 20th day of March 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.