The present invention consists in a novel self-binding fabric having a woven or knitted base and a body of mixed fusible and non-fusible fibres. The invention includes within its scope the novel process herein disclosed of making such fabric, while the fabric itself is the subject matter of my co-pending application Ser. No. 381,044, filed February 28, 1941, of which this application is a division.

Many attempts have been made to produce felt or pile fabrics having a woven base and a fibrous body united thereto by needle punching, that is to say, by superposing over the base ply a bat composed of hair or wool or other mixed fibres and then partially driving or punching the fibres of the bat through the interstices of the base or web by a needle loom. The fibres of the bat are thus projected through the bottom face of the base ply and are loosely held in place by frictional engagement with the underlying web. In order to anchor the fibres of the bat so that in wear they may not be pulled out of the base ply it has been necessary heretofore to saturate or coat the base ply or the assembled plies on one or both sides with various compounds of rubber, asphalt or emulsified compounds and such treatment limits the field of use and increases the cost of the fabric.

Another approach to the problem has been by combining thermoplastic fibres, for example, of such material as cellulose acetate, with non-thermoplastic fibres and then creating a bonded web in the homogenous mixture of fibres by subjecting them to heat and pressure. In practice extreme heat and pressure have been employed, requiring presses capable of exerting many tons pressure. The final product resembles a thin felt or structureless fabric having fibres in no set arrangement or pattern and while the resulting felt-like or paper-like sheet is useful in some fields it has definite limitations, notably it lacks the tensile strength of products which include a woven base.

In accordance with the present invention it is proposed to utilize the step of mixing thermoplastic and non-thermoplastic fibres, but to depart from the prior practice and produce a new self-binding fabric having a wide and economical field of use. More specifically in carrying out the present invention I blend on a carding machine or garnet a mixture of different kinds of cut fibres within certain limiting proportions. The percentage of thermoplastic fibre to non-thermoplastic fibre may be widely varied, the low limit being determined by the minimum amount that will satisfactorily bond the non-thermoplastic fibres, and the high limit being reached when the final product loses its character as the fibre becomes in effect a texture of fused fibres of thermoplastic compound wherein the non-thermoplastic fibres substantially lose their fibrous nature.

To illustrate, I have found that the following fibre mixture gives excellent results:

<table>
<thead>
<tr>
<th>Fibre Type</th>
<th>Per cent by weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose acetate</td>
<td>50</td>
</tr>
<tr>
<td>Cotton fibre</td>
<td>15</td>
</tr>
<tr>
<td>Jute fibre</td>
<td>35</td>
</tr>
</tbody>
</table>

Such a furnish is carded or otherwise combed into a bat with the various fibres intermingled and uniformly distributed therein. (Simple extraction of the thermoplastic fibre by a suitable solvent readily proves that a substantially uniform distribution may be brought about in this manner.) The bat thus prepared is now fed on to a pre-woven fabric base. Cotton textile material such as print cloth, sheeting or osnaberg is suitable, although for a heavier product a woven or burlap fabric may be employed as a base ply. In any event the bat superimposed on the pre-woven base is now passed through a standard needle loom and pricked or punched so that the bat becomes integrated with the base ply.

When the entanglement of the mixed fibres of the bat with the pre-woven base ply is accomplished the composite sheet is subjected to heat and pressure, as by being passed through heated rolls, and in this step of the process the fibres are flattened and firmly pressed against the base ply. At the same time the thermoplastic fibres are caused to fuse wherever they may contact in and on the interstices of the woven base and upon both surfaces thereof. The entire fibrous mixture is thus securely bonded by an internal web of fused thermoplastic fibres. The fused fibres in some instances surround the strands of the woven base, in some instances form fused hubs that cannot be drawn through the interstices of the base, and in other instances surround or are inextricably entangled with the non-thermoplastic fibres. The resultant fabric is self-binding in that it requires no extraneous binding material to anchor the mixed fibres supplied in the bat to the fabric base, but because of the continuous internal thermoplastic web or net which is formed in the process, presents permanently integrated piles. The fabric, moreover, has as a whole all the strength of the woven base with the surface appearance and body of felt or pile fabric.

The fabric thus produced may be employed advantageously and economically as a base for use in manufacturing shoe stiffeners, such as box toes, deriving sufficient strength to withstand the lasting strains on account of its woven base ply. It may be also employed advantageously for rug underlays. It is particularly useful as an underlay in clothing because it may be conformable to shape by hot pressing and is thereafter im-
pervious to moisture so that it tends to preserve its original shape in wear.

These and other features of the invention will be best understood and appreciated from the following description of one specific manner in which it may be carried out as illustrated in the accompanying drawings, in which

Fig. 1 is a plan view of a fragment of the fibrous bat assembled on an underlying woven ply, and Fig. 2 is a diagrammatic sectional view on a greatly enlarged scale suggesting the needle punching operation of uniting the bat and the base ply.

Fig. 3 is a fragmentary diagrammatic view suggesting the step of hot pressing the assembled plies of the fabric, and Fig. 4 is a view corresponding to Fig. 2 suggesting diagrammatically the structure of the finished fabric.

In Fig. 1 the woven base ply 10 may represent osnaberg, woven of cotton, approximately 4 yards to the pound which is obtainable in 40½" width and accordingly supplies a woven web of very appreciable tensile strength.

The bat 12 is herein shown as comprising cut jute fibres which may average 2" in length and which can be economically secured from picked burlap bags. Mixed with the jute fibres which comprises 70% of the total are cotton fibres averaging perhaps 1" in length and thermoplastic fibres of "Vinyon" or "Teitene" averaging perhaps ½" in length. The cotton fibres may comprise about 15% of the whole and the thermoplastic fibres the remaining 15%. In Fig. 2 the thermoplastic fibres 11 are represented in solid black, the cotton fibres 13 show as a twist, and the jute fibres 14 are represented in double lines.

The bat 12 superposed upon the osnaberg 10 is pressed through a needle loom having needles 15, a few of which are shown in Fig. 2. In this operation some fibres of the bat are carried through the interstices of the osnaberg so that some of them project a short distance below its lower surface. After the bat and its woven base have been preliminarily united as suggested in Fig. 2 they may be passed between heated rolls 16 and in this process the bat is compressed, its fibres are flattened and the thermoplastic fibres 11 are fused together, they cross or touch each other and thus a self-combining fabric is produced.

As already intimated the composition of the bat may be varied within wide limits and in some instances the cotton fibres may be omitted although they help in the carding to retain the shorter thermoplastic fibres in the mixture. However, I contemplate that for some purposes a bat comprising 15% thermoplastic fibres and 85% jute may be successfully used.

The thermoplastic or thermo-reactive fibres are preferably of cellulose acetate although any equivalent fibres may be used and merely by way of example I suggest fibres made from the conjoint polymer of vinyl chloride and vinyl acetate or polymerized vinyl acetate alone. These colloidal and synthetic resinous fibres are readily obtained on the market as Tenite and Vinyon.

The fabric of my invention may be advantageously employed as already noted in many fields as an economical and structurally satisfactory substitute for good grades of felt. It may also be finished as a pile fabric by combing and trimming the composite body of the bonded fibres.

It will be understood that the formula suggested herein above is merely typical and the best now known to me. I have referred to the jute and cotton fibres, but contemplate the employment of any vegetable fibre which may be best suited or most economically procured under current conditions. The fibre bat may also include a small admixture of wool or other animal fibre if desired although this is not usually necessary. Further, while I have suggested heated rolls for applying pressure and heat to the united plies of the material they represent only one convenient instrumentality and any adequate form of hot pressing would be within the scope of the present invention. As already noted one important field of use is in the manufacture of shoe stiffeners such as box toe blanks and where self-binding fabric of my invention is used for that purpose it is saturated in a suitable molten mixture of wax, resin and rubber which hardens when cool and converts the fabric into a stiff sheet which is then dried out and skived and so converted into blanks ready for the shoemaker's use.

Having thus disclosed my invention and described an illustrative embodiment thereof, I claim as new and desire to secure by Letters Patent:

1. The process of making self-binding fabric having a woven textile base, which consists in mixing non-fusible and fusible fibres into a bat, needle punching the bat upon a textile base, and then subjecting the two plies thus formed to heat and pressure to fuse the latter fibres into an anchoring web on both sides of the textile base.

2. The process of making a pile fabric having a textile base, which consists in mixing vegetable fibres and resinous fibres into a bat, needle punching the bat upon a textile base, and then subjecting the two plies thus preliminarily united to heat and pressure to fuse the resinous fibres into an anchoring web preliminarily incorporated in the two plies, and then heating and finishing the mixed fibre surface.

3. The process of making composite sheet fabric for shoe stiffeners, which consists in mixing cotton fibres, jute fibres and fibres of cellulose acetate into a bat, needle punching the bat upon a textile base, and then compressing and heating the two united plies to fuse the cellulose acetate fibres into an anchoring web which is engaged with the said textile base.

4. The process of making a composite sheet fabric having a woven base, which is characterized by the steps of mixing vegetable fibres with shorter fibres of a synthetic resin to form a substantially homogeneous bat, needle punching the bat upon a woven base and thereby carrying some of the mixed fibres through the base, and then heating and compressing the plies thus united to fuse the resinous fibres together in and on the interstices of the woven base.

5. Process of making a composite sheet fabric having a woven base, which is characterized by the steps of mixing jute fibres in approximately 2½" lengths and substantially 70% of the mixture, cotton fibres in approximately 1½" lengths and substantially 15% of the mixture, and cellulose acetate fibres in approximately 1¼" lengths and substantially 15% of the mixture, to form a bat in which the mixed fibres are uniformly distributed, needle punching the bat upon a woven base, and combing and carrying some of the mixed fibres through the base, and then heating and compressing the plies thus united to fuse the cellulose fibres together into an anchoring web.

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