This invention relates to fibrous materials and in particular to sheet materials suitable for use as duplicating-stencil tissue.

Duplicating-stencil tissue is normally made from the fibres of Japanese mulberry bark, by a process in which the fibres are deposited from an aqueous suspension on to a mesh to form a web. It is the principal object of the present invention to provide a duplicating-stencil tissue from materials which are freely available in this country.

Attempts to form suitable sheet materials from regenerated cellulose staple fibres were unsuccessful owing to the difficulty of obtaining the desired degree of cohesion in the sheet material formed. Various methods of increasing the cohesion, for example by employing cellulose derivative adhesives such as methyl cellulose, and cellulose solvents such as complex compounds of copper with organic bases, also proved unsuccessful.

We have now found that a suitable sheet material can be provided in the form of a web of regenerated cellulose staple fibres in admixture with adherent staple fibres of a thermoplastic derivative of cellulose.

The staple fibres are preferably all of the same denier and staple length, and the best results have been obtained by mixing the two kinds of staple fibre dry on a carding machine and collecting the resulting web off the doffing cylinder of the carding machine on to a rough surfaced paper. The web obtained in this way may be folded in two to give a heavier and more even web. Naturally the proportion of cellulose derivative fibres in the mixture must be sufficient to bond the web into a coherent sheet. The best results have been obtained using equal proportions of the two kinds of fibre.

To render the cellulose derivative fibres adherent and convert the web into a coherent sheet, it may be pressed between sheets of fabric at an elevated temperature in the presence of a liquid which assists the flow of the cellulose derivative without, however, causing the fibres to stick to the enveloping fabric layers. The nature of the assisting liquid depends upon the properties, and especially the softening temperature, of the particular cellulose derivative employed. With cellulose acetate of the grade used for artificial silk production, which contains about 53 to 54.5% of combined acetic acid, inert liquids such as water are somewhat defective in softening power even at the highest pressing temperatures which can be employed without damage. In consequence, webs obtained by pressing in the presence of water alone are apt to be uneven and fluffy. Attempts to obviate this difficulty by incorporating a plasticiser with the cellulose derivative fibres were found to cause sticking of the web to the enveloping layers of fabric. This difficulty of adhesion to the layers of fabric was also found when using, instead of water, an active solvent such as acetone, dioxane, or methylene ethylene ether, diluted with up to about its own volume of water, or a potential solvent for cellulose acetate, that is a liquid which becomes a solvent at elevated temperatures, for example methanol, ethanol, or isopropanol, diluted with about 25% by volume of water. Satisfactory results, however, were obtained by the use of very much more dilute solutions of an active solvent for the cellulose acetate, for example acetone or dioxane diluted with 8 or 9 times its volume of water, and an assisting liquid which gave even better results was obtained by diluting industrial alcohol with about 3 times its volume of water. In general 20–30% (by volume) aqueous solutions of methanol, ethanol, or isopropanol are satisfactory softening agents and a satisfactory temperature for pressing will be between 120 and 150°C.

The invention may be illustrated as follows:

Staple fibres of cellulose acetate of 3½ denier and 1½ inch staple length, together with regenerated cellulose staple fibres produced by the viscose process and of the same denier and staple length, are fed in equal proportions by weight to a carding machine. The resulting web is collected off the doffing cylinder on to a rough surfaced paper, folded in two, and sandwiched between two layers of a woven fabric of high tenacity regenerated cellulose. The assembly is immersed in a solution containing 25 parts of industrial alcohol and 75 parts of water, the parts being by volume, and then pressed between two layers of cotton fabric each backed by two layers of woolen fabric, in a steam heated platen press, for 3 minutes at 140°C under a pressure of 40 to 50 pounds per square inch. In this way a web is formed in which the cellulose acetate fibres are bonded together but which can readily be peeled off from the enveloping fabric. The web weighs about 0.97 ounce per square yard and is approximately 0.07 mm. in thickness. It is even in thickness, has a smooth surface free from fuzziness and is suitable for use as a duplicating-stencil tissue.

It is an advantage of the process of the invention that it does not involve subjection of the staple fibres to severe mechanical action tending
to shorten the fibres, such as occurs in the production of pulps for paper-production. The avoidance of such mechanical action coupled with the adherence of the thermoplastic fibres enables products of high strength to be obtained. The denier and staple length of the fibres used may be varied within certain limits. Thus, fibres of denier less than 3½, for example fibres of denier 2, 1, or even less than 1, can be employed. The denier can be somewhat higher than 3½, e.g. 4, but should not be substantially higher than about 5. The staple length may range from about 1 inch or even less to about 2 inches.

The regenerated cellulose fibres have been described as made by the viscose process. Regenerated cellulose fibres made by other methods may, however, be employed. For instance the fibres may be made by the cuprammonium method or by the saponification of cellulose ester fibre, especially high tenacity cellulose ester fibre obtained as the result of stretching dry-spun cellulose acetate fibre, preferably in the form of yarns of continuous filaments, to a considerable degree, for example to 3 to 10 times its original length in steam or hot water.

Methods of production involving stretching during spinning (as, for example, in the stretch-spinnng of cuprammonium regenerated cellulose fibre) or after spinning (as, for example, in the steam-stretching of dry-spun cellulose acetate fibre), enable fibres to be obtained of high tenacity, e.g. 2 to 4 or 6 or more grams per denier, and of low denier, e.g. between 2 and 1 or even less than 1. Very strong, thin tissues can be made when the regenerated cellulose fibres are made by such a process.

Instead of cellulose acetate fibres, staple fibres of other thermoplastic derivatives of cellulose may be used. Examples of such derivatives are other carboxylic acid esters of cellulose such as cellulose propionate, cellulose butyrate, cellulose acetate sebacate, cellulose acetate palmitate, and cellulose acetate laurate; and ethers of cellulose such as ethyl cellulose, propyl cellulose, and benzyl cellulose. The staple fibres may be obtained by cutting a multi-filament yarn obtained by a dry-spinning operation from a solution of the cellulose derivative; or by stretching such a dry-spun multi-filament yarn in steam or hot water to produce a high tenacity yarn and cutting this into staple fibres; or by cutting into staple fibres a multi-filament yarn of the derivative of cellulose, formed by a wet-spinning operation.

The invention includes the provision of sheet materials of the structure referred to above for purposes other than for use as duplicator-stencil tissue, e.g. for use in electrical insulation and in protecting highly polished surfaces against scratching.