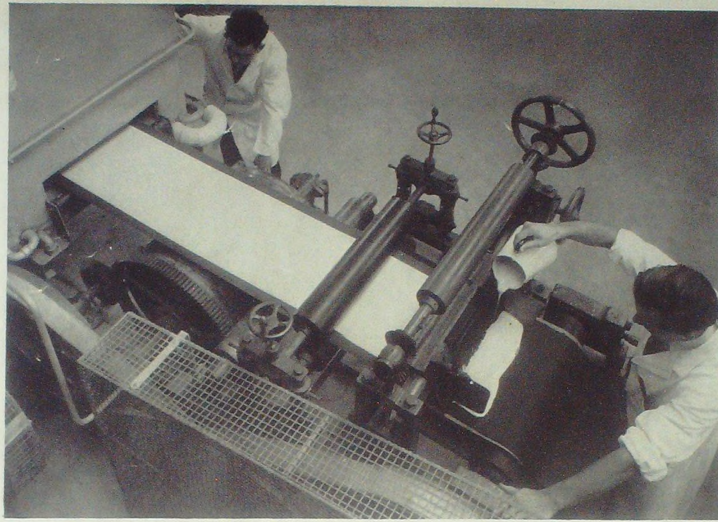

Applying latex foam compound to carpet back. (Courtesy—Revertex Ltd.)

[*Frontispiece*

NATURAL
RUBBER LATEX
AND ITS APPLICATIONS

No. 5. THE APPLICATIONS OF LATEX TO TEXTILE AND ALLIED MATERIALS

By
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PREFACE

APPROXIMATELY 90% of the rubber sold as manufactured products contains a textile material in one form or another, and, in fact, the rubber industry in the United Kingdom uses about 40,000 tons of textiles per annum. Yet this is considerably less than 10% of the total consumption. Potentially therefore there exists in the textile industry a substantial outlet for rubber if methods can be evolved and advantages found for its application as a finish for materials of one kind or another. It was to explore the possibilities in the case of wool that I became, many years ago, interested in this wide field of latex application to textiles.

Other booklets in this series have described and discussed processes which are established industries—casting, dipping and latex-foam sponge manufacture—and they are being carried out by a number of firms up and down the country. Latex applied to textile is a much more diverse subject, and while there are a few processes comparatively widely worked, such as carpet backing and the treatment of rayon cords with latex-casein or latex-resin dopes to improve adhesion, many of the uses are individually small and confined to one or two firms. In consequence my approach to this subject has been different from that of my co-authors in the series, and an attempt is made not only to record what is being done but also to indicate the possibilities for rubber usage, and pin-point the important theoretical and practical considerations.

My thanks are due to my several former colleagues with whom and from whom I have gained my limited knowledge of the other industry. Acknowledgement is also made for assistance from many firms and individuals with the supply of the photographs and diagrams.

C. M. B.

August 1954.

Chapter I

INTRODUCTORY

RUBBER and textiles have been associated in manufacture since the early days of the rubber industry when MacIntosh produced his waterproof cloth by combining two textile fabrics by means of a layer of rubber. Many of the most important and widely used rubber products depend on a textile in one form or another to give them increased rigidity, increased strength and, in some cases, increased life. It is, furthermore, no exaggeration to say that as much research has gone into the textile side as into the rubber side of the manufacture of such important items as tyres, belting and hose. This booklet, which is one of a series dealing specifically with latex rather than with dry rubber, attempts to cover the wide field of the use of rubber latex with textiles, not only for the production of what are commonly termed rubber products but also for products in which the textile quality more or less predominates.

The arrangement of the booklet has presented considerable difficulty—due to the wide diversity of processes and products. No logical arrangement based on one single variable appeared satisfactory, owing to the large amount of cross-referencing that would be necessary.

As raw materials, consideration is given to animal and vegetable fibres, and, for the sake of completeness, it has been felt desirable to include reference to the newer synthetic fibres and also the mineral fibres such as asbestos and glass. Furthermore, paper and leather, which are not strictly textiles, have been included. On the other hand, rubber thread is not discussed.

In the case of the true textile fibres, they can be treated with rubber in a wide variety of forms, representing the different stages in the production of the finished textile. Carded webs find application in the preparation of bonded fabrics, yarns are treated for incorporation into belting and tyres as well as for weaving and knitting, and fabrics and felts of all types are processed in many ways with rubber latex.

When we consider the function that the rubber has been proposed to perform when applied to the materials referred to above, we arrive at a comprehensive list which includes waterproofing and rot-proofing, imparting crease-resistance, sealing and binding as well as simple adhesion.

A large amount of the effort directed to the application of rubber to textiles has been concerned with the mechanical problems of handling the textile material in whatever form through the process, whether it be impregnation or surface coating by spreading or spraying. Some attention, however, has been given to the more subtle colloidal and chemical modifications of the rubber latex so as to produce special types of rubber deposition on the textile.

Finally in these introductory remarks attention is drawn to the wide diversity of the products and the industries into which the rubberizing of textile or allied materials has penetrated. To name only a few: clothing, boots and shoes, upholstery and bedding, carpets and flooring materials of various types, felts, ropes and cables, specialized fields such as printers' blankets and brush-making and a wide field covered by the term "artificial leather". All these outlets are in addition to the main rubber industry, which, as indicated above, makes many important products containing textile material.

It is quite obvious that it would be impracticable to sectionalize this booklet according either to the type of fibre involved, to the form in which the fibre is used, to the property imparted by the rubber or to the finished product. It has, therefore, been thought desirable to select the important developments, sometimes by products and sometimes by processes, and deal with these in separate sections, relying upon an adequate index to guide the reader to the source of the information which he is seeking. It will be necessary, however, to describe in some detail the general principles involved and the basic processes which have so far been developed and applied.

The rubber latex may be used in its raw unvulcanized state, or after pre-vulcanization, or again after compounding with ingredients which will subsequently bring about the vulcanization of the rubber. This is a general question which has to be considered in the case of each particular application, as will be apparent from the introductory booklet of this series. Generally speaking, vulcanization at some stage is to be preferred, unless the self-adhesive characteristic of the unvulcanized rubber is an essential part of the process or the application of the product. In many applications for rubber latex the compounding of the latex with fillers is worthy of considerable attention, but in the case of textile treatment it is a fair generalization to state that the addition of fillers other than as the compounding ingredients necessary to bring about vulcanization is not usually carried out. The addition of any filler to latex will reduce the strength of the rubber, and it is obviously more economic in the case of textile applications to use less rubber than to weaken it by loading it with filler.

With the possible exception, therefore, of spread-films applied to fabrics for waterproofing purposes, little attention will be paid to compounding. On the other hand, what may be termed the colloidal characteristics of the latex play as great a part in textile treatment as in any other latex-consuming process. Textile fibres frequently contain foreign surface-active materials and are subject to *p*H changes during their normal processing, such as scouring and dyeing. With these changes go changes in the electric charges carried by the fibre surfaces, of which account must be taken, bearing in mind that the rubber-latex particle also carries an electric charge. Changes of *p*H can, furthermore, bring about flocculation and coagulation of the rubber particles which may, or may not, be a desirable state of affairs in the treatment of the textile.

One method of overcoming these difficulties of foreign matter on the textile fibre is by excessive stabilization of the latex, but, as will be apparent from what follows, the subtle changes that are produced in the textile fibre can be used to advantage in the working of rubberizing methods.

The other general subject that frequently arises is the question of obtaining the necessary adhesion of the rubber to the textile. This problem is most acute when films of rubber are applied to textile fabrics and such films are required to stand the flexing and abrasion as occurs, for example, in a mackintosh fabric. It is also important when the fabric has to be incorporated in a product such as a tyre or belt, where failure of the adhesion will result in rapid deterioration of the product. Chapter V deals with this particular problem of rubber adhesion to textiles in so far as it has been studied from the latex or water-dispersion standpoint.

Chapter II

GENERAL PRINCIPLES INVOLVED IN THE APPLICATION OF LATEX TO TEXTILES

WHEN embarking on the application of rubber latex to any textile, paper or allied material at some stage of manufacture, the decision has to be made as to precisely what property it is required to impart to the material by the treatment with rubber. As indicated in Chapter I, the earliest and one of the most widespread uses of rubber in the textile field is for waterproofing by coating the material with an impermeable rubber deposit. The latex for this is customarily spread on the fabric, and the water removed by evaporation to leave a continuous film of rubber. The excellent film-forming properties of rubber latex make the production of such a film a comparatively simple matter.

Steps have to be taken to ensure sufficient stability in the rubber dispersion so that coagulation does not take place under the action of spreading. The first problem that often arises in connection with the simple spreading process is that of the adhesion of the dried film to the textile material. If the material to be coated is of very fine pores the rubber particles in the latex will not penetrate any appreciable distance into the material, and adhesion will be correspondingly poor. The absorbancy of the textile will produce a filtering action on the latex. Some improvement can be obtained by the use of wetting agents incorporated in the latex. These wetting agents, as their name implies, assist the latex to spread over the surface of the fibres, and, in spreading, more penetration takes place into the interstices of the material. These wetting agents will not, of course, reduce the filtering action if the pores are too fine to admit the rubber particles, and penetration will be reduced if fibre and particle carry like electric charges leading to mutual repulsion.[1] The practical aspects of fabric coating are more fully discussed in Chapter IV and the adhesion problem is considered in Chapter V.

Next we can consider not so much a surface coating as an im pregnation, implying a uniform distribution of rubber throughout the textile material to fill the interstices between the fibres. If the quantity of rubber applied is sufficient, similar waterproofing action will be imparted as in the case of a spread coating, and the rubber will appear on both sides of the textile. But generally speaking impregnation is attempted not so much for waterproofing but rather for subsequent use in textile-rubber products, such as tyres, belting, etc., where fibre insulation and compaction are required to increase fatigue life. In the literature there has been discussion on the subject of impregnation, and frequent references are made to "impregnation of the fibre". This matter is discussed by Stevens,[2] and his general conclusion, which is the widely held view of those who have studied the matter scientifically, is that the rubber particles in latex are too large by many times to enter the lumen of the fibre. Impregnation is, therefore, only applicable to the filling of the spaces between fibres, and it is obvious that, in many cases, that is what the patentee or author means when he talks of impregnation of the fibres.

In practice, materials may appear to be fairly thoroughly impregnated, whereas, in fact, the impregnation has not got to the stage of filling the spaces between the fibres, but only filling spaces between the individual yarns or threads of a composite cord or fabric.[3] The value of wetting agents in improving the degree of impregnation has been stressed from time to time, and in particular was the subject of a paper by Hauser and Huenemoerder.[4] The impregnation to which we have referred so far is carried out under such conditions that no coagulation or deposition of the rubber particles occurs, except by evaporation of the water content by heat or other means—in other words, a simple entrainment process has been considered so far. The material is passed through a latex composition and the excess is squeezed out as in a usual padding process. Alternatively the latex is sprayed onto the fabric.

There are several references to the use of differential pressure to assist impregnation, and these are discussed in Chapters III and IV (316335, 361398, 391031).* From the point of view of the discussion in this chapter they are improvements in the simple entrainment process and not fundamentally different in principle.

* The six-figure numbers that occur in brackets throughout the text are numbers of British patent specifications, abstracts of which are given in Chapter XII.

As is pointed out by International Latex Processes in their patents, the alternative to entrainment is immersion (580134). In immersion processes, the fibrous material is introduced into a bath of latex and conditions are arranged so that some or all of the rubber is deposited on the fibres; for example, by the application of heat, by the addition of coagulant or by the neutralization of opposite charges on rubber and fibre.

In fact, for many years the problem of applying rubber latex to textiles, in such a way that the particles are deposited on the fibres and the rubber is not dried off as a film throughout the product, has been studied. The first and most obvious step is to use a coagulating action of acids or salts on rubber latex, and there are early patents for the treatment of textile material with a coagulant, sometimes called a mordant by analogy with dyeing procedure, either before or after passage through a rubber-latex bath. Substances suggested are ammonium sulphate, tannates, etc. (337359).

Another idea is to use the mutual coagulation between negatively charged and positively charged particles. For the former a weakly alkaline latex is used, for the latter a strongly acid latex prepared by the removal of some of the ammonia from normal preserved latex, addition of ammonium caseinate and then dilute acetic acid to acidify and reverse the charge; the final latex will contain 25% rubber, 0·4% casein and 5% acetic acid. The two latices are applied to the two sides of the fabric, and, after rinsing, a substantial thickness is found to have been built up (350106).

Such methods, however, do not result in a true deposition of the rubber particle but only in the precipitation of one particle on another, and to all intents and purposes a rubber film is again obtained.

Reading the patent literature, it is obvious that the disadvantages of entrainment processes and coagulant-immersion processes have been realized for many years, and improved immersion processes have been striven after very earnestly. Broadly speaking, the aim has been the choice of the conditions of fibre and latex so as to bring about a deposition; that is to say, a process whereby the latex saturates the textile material, and the rubber is deposited to such an extent and so completely that a clear liquor can be expelled from the treated textile.

It is not easy to deal with this particular aspect in a detached way, but it is fair to say that the methods involved are divided into those which use an essentially unstable latex so that the introduction of fibrous material, because of its adsorbancy of ions or other substances, its large surface area or its content of soluble matter, causes deposition; and on the other hand, those where the latex is stabilized and deposition arises directly from a difference of charge on fibre and rubber particle.

As far as can be judged, the methods of Brandwood, and co-workers Lejeune and Bongrand, depend on the former process, and are discussed in more detail in another section of this book. These processes represent a serious attempt to tackle the problems, and considerable success has been achieved. Affinity between fibre and rubber in the author's opinion is not established by the methods of these workers. There is a great difference between affinity of rubber particles for the fibre and environmental conditions whereby the rubber particles will come out of fine suspension into a coarse, flocculent dispersion, or an actual coagulum. This is not to say that the latter methods (554572) have not their applicability. They have, in fact, been adopted and are commercially successful in the field of cotton yarns and fabrics, applications where rubberiness imparted to the textile is not detrimental to its function, They have also been successful in paper manufacture to some extent. When one comes to consider a wider aspect of the problem, including textiles such as wool and hair, the rubberiness imparted by such coagulation or precipitation methods is quite unsatisfactory.

One method by which the affinity of the rubber for the fibre can be increased is by arranging for opposite electrical charges on the two surfaces. This has been discussed by Blow in several papers.[5] The charge carried by the rubber particles and also by fibre surfaces depends upon the *p*H of the water phase in which they are present. The point at which the change-over takes place, and at which, therefore, the charge is nil, is called the isoelectric point and varies somewhat from fibre to fibre and from dispersion to dispersion. In the latter case the charge arises from the surface protective layers on the particle, and in the former case the chemical characteristic of the fibre as well as the presence of adsorbed substances determine the charge. In both cases the predominant charge of the surface can be changed; by modifying the adsorbed material as well as by altering the *p*H. This is illustrated in the accompanying diagram for a rubber particle in water, Fig. 1. It is possible, therefore, to choose two or more sets of conditions whereby the charge of the fibre and the charge of the rubber are different in a medium of the same *p*H, and mutual precipitation resulting in deposition of rubber particles onto the fibres takes place.

Fibres, in particular wool, carry a negative charge in alkaline medium and a positive charge in acid medium. A protein-stabilized rubber particle has the same charges under these condi-

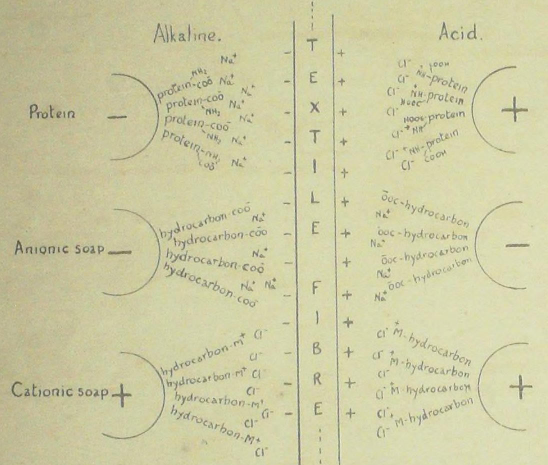

FIG. 1. Diagrammatic representation of rubber particles stabilized with protein, anionic soap and cationic soap in alkaline and acid aqueous media showing the sign of the charge in each case.

tions. Soaps, or the like, not being amphoteric give to the particle of a dispersion the same charge over as wide a range of *p*H as they are chemically stable—anionic soaps produce negative charges, cationic soaps positive charges.

Blow's processes (483496, 497793) exploited the latter, as did Brew's also (557611). Shortly after the appearance of the "Positex" patents, as they have become known, patents appeared under the name of International Latex Processes which described what the author is inclined to believe to be the corresponding "Negatex" process, i.e. negative acid latex in contrast to positive alkaline latex (508136, 508137). The patentees refer to it as being stable at the temperature of treatment when not in contact with the particular fibrous material, but unstable in its presence. One patent covers the use of latex outside the isoelectric zone, and the other the use of latex within the isoelectric zone. The *p*H figures are all very low, and the formulations contain substantial amounts of anionic surface-active stabilizers.

From the published information there is no doubt that deposition of rubber onto fibres of most types can be brought

TABLE 1

Results of treating wool fabric with 5% rubber latex under varying conditions

*p*H (Approx.)	Charge		% Rubber Content of Fabric
	Fibre	Particle	
Alkaline:			
10·5	−	−0·66*	0·25
10·5	+	−0·66	10·00
10·5	−	+0·35	11·50
Acid:			
4·0	+	+0·42	2·00
4·0	−	+	—
4·0	+	−0·47	6·50

* arbitrary units

about by adjustment of the stabilizer type and content in the latex and its *p*H, and that at least at dry-rubber contents below 10% such latices are stable in the absence of fibrous material.

Working with wool, as the published papers show, Blow examined the available possible methods and correlated particle-charge value and sign—determined by cataphoretic methods—with the deposition that occurs (see Table 1). On the basis of this work and not for any theoretical reason the use of cationic soap treatment of the latex was advocated, and the positively charged latex appeared on the markets as "Positex" in the United Kingdom and "Xetal" in France. The practical implications of this fact find no place in this chapter, which is concerned to establish the basic principles for the application of latex to textiles. No other natural rubber latex has been marketed solely for the treatment of textiles as a finishing agent.

Spreading or coating, impregnation and deposition are alternative but not interchangeable ways of applying latex to textile. They are carried out with different types of latex and different techniques, and they impart different properties to the final product. For the latter reason the choice of textile to be treated by each particular process for each particular product is critical.

Chapter III

THE TREATMENT OF YARNS, THREADS, CORDS AND THE LIKE

PARTICULARLY for the incorporation of cotton- or rayon-reinforcing yarns in rubber products, attention has been paid to the rubberizing of the individual thread to improve its adhesion to rubber subsequently applied to it, to reduce internal friction between the fibres during flexing, and to give increased strength by the binding and anchoring property of the rubber. In general, yarns are strengthened by twisting the fibres together, firstly as single yarns, and then by folding and cabling these individually twisted yarns into what is usually termed a cord.

The choice of twist at the various stages, so that the finished cord is balanced and does not snarl, is a matter for the textile technologist. At the point of maximum strength obtained by twisting the fibres, breakage of the yarn or cord occurs by the breaking of the fibres. With very much lower twists or with a single soft-twisted thread of equivalent weight per unit length, breakage would occur to some extent by slippage of the fibres over one another. Associated with the improved strength obtained by twisting is a certain degree of elasticity in the cord, due to the fact that the fibres are at an angle to the axis of the thread and can move relative to one another in the same way as a piece of fabric cut on the bias has stretchability. This stretchability arises partly from the elasticity of the individual fibres, but mainly from the structure and arrangement of the fibres. On the other hand, a simple roving, in which the fibres have been given only a small amount of twist and therefore lie approximately parallel to the axis of the thread, shows very little elasticity until slippage takes place. If, therefore, in the case of roving, the fibres are bound together with an adhesive, strength is gained without the stretchability, which in many applications is an undesirable feature of the cabled cord.* If the binder in our roving is of a flexible material such as rubber, the yarn remains pliable and has the properties of strength, low stretch and fairly ready adhesion to subsequent applications of rubber.

Several patents granted to J. Brandwood cover the treatment with rubber latex of yarns, threads and rovings. Brandwood achieved the treatment of the yarns in cheese form, i.e. wound onto perforated formers or bobbins, using dilute rubber latex and a differential-pressure technique to secure thorough impregnation. The excess latex was subsequently removed by air blast so that the adhesion of one yarn to another in the package was not so great as to interfere with unwinding after drying. His patents covered the subsequent folding and doubling of such yarns as well as the application of a slight twist to the yarn, either before or after complete drying. Furthermore, stretching while drying is also used to reduce the final stretchability. These yarns were claimed to be suitable for tyres and belting due to their low stretch and other properties, as referred to above.

In one or two of these patents there is confusion over the term "impregnation", and, as already stated in Chapter II, undoubtedy the author of the patent is using the word to mean penetration *between* the fibres. In Brandwood's patents, details of the quantity of rubber actually applied are conspicuous by their absence, although the concentration of latex used is mentioned on several occasions (408931, 435395, 512558, 514772, 519665, 521196).

Other patents of a similar nature were granted to Fenner and his collaborators for treating textile yarns, not rovings, with rubber latex, again under vacuum. In many cases these patents were concerned specifically with beltings and included the further treatment of the woven fabric of the semi-finished belts (430035). To increase the amount of rubber deposited on the yarns coagulation baths were used.

A process described (468428) consists of the following steps in the treatment of yarns:

Firstly a scour in 0·1% NaOH bath, followed by drying to 15% moisture; then a pass through 30% latex compounded and containing a wetting agent, e.g. ammonium oleate; next through a more concentrated latex, followed by an acetic

* In passing, it may be stated that there are other methods of reducing or eliminating the stretchability of a cord, depending on pre-stretching and setting in this condition.

acid coagulant bath; the yarn is then washed, and zinc stearate or stearic acid in alcohol is applied to reduce tack and ease subsequent weaving.

Other processes described include pre-treatment with coagulant and passage through a flexible rubber diaphragm followed by immediate rapid drying (477393).

In another process the twist is taken out of the yarn temporarily while being treated with latex so as to assist still further the impregnation.

The third process for the impregnation of yarn is the Filastic process, a number of patents being in the names of Lejeune and Bongrand. The process consists of the modification by chemical means of the surface activities of the cotton fibres to assist the impregnation process which is carried out by alternating vacuum and high pressure with subsequent drying of the yarn.

Reference is made in the patent specifications to impregnation of roving on the spinning frame with means for squeezing out excess impregnant and recovering same. Short fibres with small twist in the thread give as good results as long fibres with greater twist and the threads so produced are without fluff and have a polished or glazed surface.

The impregnation of yarns on bobbins or in hanks is also possible by these processes, it being emphasized that time of contact, use of vacuum and/or pressure are important factors. By keeping textile material in an alkaline (ammonia) atmosphere during treatment the latex does not dry or coagulate and time is given for more complete penetration (338381, 344414, 405032, 405311, 405312, 405313). A number of supplementary patents taken out by Filastic Ltd. cover the use of these latex-treated yarns in hose, for weaving into fabrics to be used in belts and flexible couplings, for the manufacture of brake linings and also in connection with filter cloth, nets, shoe soles, etc. (410116, 411460, 411887, 411937, 411938, 411939, 412229, 412256).

Whereas earlier patents refer solely to cotton, its extension to asbestos is also covered later. In this case the fibres are first treated with a liquid having a *p*H value equal to that of the rubber latex, i.e. 9·0 (414692).

Subsequent patents deal with needs of pneumatic tyres (416048, 422960, 437286). In this connection Firestone have a patent for treating the yarns during the doubling or folding feature of the cabled cord.* If the binder in our roving is of a flexible material such as rubber, the yarn remains pliable and has the properties of strength, low stretch and fairly ready adhesion to subsequent applications of rubber.

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Allied with the treatment of yarns is the treatment of ropes, cords and the like, and suggestions have been made for applying latex to these materials to smooth their surfaces, particularly in the case of manilla, sisal, etc. In many cases there is no attempt to get thorough impregnation, but only to achieve sufficient to give a coating adherent to the surface (178811, 315304, 340051, 404001).

An artificial horsehair for upholstery is made by drawing a thread through a nozzle fed with latex or other liquid coating preparation. The rubber is dried and vulcanized and may be compounded. The "thread" or "hair" may be formed into shaped masses or curled by suitable techniques before drying and vulcanization (457140).

In 1932 Pestalozza laid down the three criteria for impregnation: very loose twist of the yarn (i.e. an open or full yarn); low tension, since obviously tension longitudinally will narrow the spaces between fibres; and wetting with soap solution to overcome surface tension forces (408213).

The use of roving, i.e. untwisted or very lightly twisted yarn, mechanical devices to untwist the yarn in the bath, pressure differences and such mechanical devices all assist very materially. Commercially the Filastic and the Fenner processes have succeeded mainly for belting, but for tyres cost has probably militated against the wider use of the ideas.

The patents of Lejeune and Bongrand refer to bringing about coagulation, and it has been claimed[6] that conditions are such that an actual deposition of the rubber particles on the fibres is obtained. In the case of cotton, it is undoubtedly possible to achieve something at least allied to deposition by adjusting the stability of the latex. The processes already referred to above allow the treatment of yarns in bulk, that is to say either in hanks or in bobbins, provided that the counts are low; the yarns are of relatively large diameter and weight per unit length.

Difficulties arise, however, when the yarn is of finer counts and correspondingly weaker. A small amount of the rubber is then sufficient to adhere one yarn to the adjacent yarn, so that unwinding becomes impossible. With a true deposition and exhaustion process, however, this does not arise, and therefore there is opened up the possibility of treating single yarns for subsequent doubling and cabling into cord, which would have largely the characteristics of the normal cord but would be completely impregnated with rubber providing insulation and resistance to fatigue and flexing conditions. Experiments carried out on these lines in the case of cord subsequently to be built into tyres showed improved life, due no doubt to the insulating action of the rubber between the fibres, and also to some extent due to the slightly improved adhesion of the rubber applied subsequently by the normal spreading or friction processes.

For example, a singles 20's cotton yarn of the normal twist is wound into hanks or on to cheeses and treated with a positively charged, cationic-soap-stabilized rubber latex after thorough alkali scour and rinse. The ratio of latex to cotton is 20 or 30 to 1, and there is sufficient rubber to apply 5–7% (dry rubber) to dry cotton; the rubber for this application does not contain vulcanizing ingredients since those present in subsequent spread coats will suffice and the unvulcanized rubber will adhere well. By suitable circulation of the liquor and control of *p*H, deposition of 80–90% of the rubber will occur. After removal of as much as possible of the exhausted liquor from the bulk of yarn it is dried and rewound for folding and cabling, for example, into a 3/5/20 cord for tyre or belt manufacture.

This process is described by Blow in his published papers and the pamphlets on Positex issued by the British Rubber Development Board, and is, of course, applicable to yarns of all counts. For yarns and threads to be incorporated in rubber products as a reinforcement the other entrainment and immersion processes are applicable and are perhaps simpler when small counts are involved. In other words, the applicability of Positex in this particular field is restricted in all probability to a process like that just described.

Because the impregnating processes of Brandwood, Fenner, and Bongrand and Lejeune give rubberiness to the textile, they are not applicable, as far as the author is aware, to essentially textile materials, e.g. wearing apparel. The true deposition processes with low amounts of rubber applied are, however, of interest in this latter field, particularly in the case of wool. Although details are given in the B.R.D.B. pamphlets on nearly the whole range of fibres, the development and interest have been largely confined to wool materials.

We conclude this chapter, therefore, with a brief account of the methods of treating wool yarns with rubber by means of positively charged latex. As already indicated in Chapter II, deposition of rubber onto fibre is brought about by arranging the charge on the former positive and that on the latter negative in the same medium. An alkaline medium ensures a negative charge on the fibre, and treatment of the latex, so that the protective layer on the particle surface is cationic soap, achieves the positive charge required of the rubber. By way of explanation it is pointed out that ordinary soaps are chemical compounds consisting of a hydrocarbon chain with a hydrophilic head which in water is the surface-active anion. Cationic soaps are the converse in so far as the surface-active long hydrocarbon chain is the cation or positive ion. This is further explained in Fig. 1.

It is perhaps obvious that the required fulfilment of the ideal takes place when only the cationic soap, rubber particles, fibre and alkali, to give the correct *p*H, are present in the aqueous phase. Any anionic soap material, residual acidity in the fibres, etc., can upset the colloidal state of balance and reduce the amount of deposition and/or lead to anomalous behaviour. This was discussed in Positex Pamphlet No. 3, but since its publication shortly after the war marked developments in the detergent field have occurred. While it is interesting to know that anomalous behaviour can take place due to the residual soap in the yarn and other causes, the position is radically changed from the practical standpoint. Non-ionic detergents are now available which can be used if not for the whole scouring process at least for the final stages of the preparation of the wool for treatment. These materials, as their name implies, produce no charged ions that can interfere with the fibre or rubber particle charge, and therefore any traces present will have little, if any, effect on the deposition process.

Whereas, therefore, when the Positex processes were developed prior to the war and reconsidered immediately after the war, ingenuity, skill and additional processes were admittedly often necessary to obtain the yarn or fabric in the condition where deposition occurs satisfactorily, nowadays these practical difficulties are passing into the background.

The recommendation is, therefore, that the goods be scoured according to the detergent maker's instructions in a non-ionic soap and well rinsed and hydroextracted. The treatment of fabric which differs somewhat from that of yarn is discussed in

Chapter IV. Yarn can be treated at high-liquor ratios, i.e. 1 volume of yarn to 10–30 of the positively charged latex of suitable concentration to give the required rubber content on the final textile, and the handling should be such that there is gentle motion of the liquid relative to the fibre whether in a hank-dyeing or a cheese-dyeing machine. The *p*H should be approximately 9, obtained by ammonia addition, and no elevation of the temperature is necessary or desirable. Deposition takes place in 5–30 minutes, depending on conditions, and the residual liquor should be substantially clear of rubber. The yarn can be hydro-extracted gently and dried. It should, perhaps, be emphasized that the attachment of rubber to fibre before this final drying is by electrostatic forces, and if mechanical agitation is too severe the deposition can be disturbed.

In passing, it may be remarked that the rubberizing by a substantive process as just described opened up great possibilities for yarn treatment, but, as referred to in Chapter VI, where the properties of rubberized materials are discussed, developments have not progressed in this direction so well as in other fields.

From what has been written in this chapter it is obvious that the impregnation and deposition processes have been thoroughly investigated and in certain products rubberized yarns have been successfully used.

Chapter IV

FABRIC PROOFING, COATING AND IMPREGNATION

As in the case of dipping, the attractiveness of latex for fabric coating lies in its greater solids content and freedom from inflammable and toxic solvents. On the debit side is the greater cost of rubber in latex form and the fact that loading with fillers causes a much greater deterioration of properties than in the case of raw rubber.

The garment-proofing trade is still almost 100% based on solvent spreading, not only because of these disadvantages but also because of the harsh feel and stiffness of a latex proofing compared with a cold-cured solution coating.

Nevertheless there is a field for latex spreading and coating.[7]

Latex spreading of the backs of pile fabrics, e.g. carpets and rugs, is widely practised and is discussed in Chapter VII. Here the purpose is improved durability, replacement of the normal size and conferment of non-slip characteristics. Felts, and in particular needleloom felts, are also commonly spread with latex to increase strength and durability.

The basic principles are to pass the fabric under a doctor blade in front of which is placed the latex mixture, and then over a heated platen or round a drum drier to dry off the water; additional coats being added in the same way to bring the thickness of film to that required. (See Figs. 2 and 3.)

It is not unusual to modify the normal solution spreader so that spreading is carried out with the fabric forming a trough under the doctor blade or a roller. The fabric is subsequently taken upwards and then over the drying chest. Less danger of coagulation arises with this arrangement (319726). (See Fig. 4.)

One of the frequent troubles with latex spreading is so-called "striking through", i.e. penetration through the fabric to form local areas of rubber on the reverse side. There are several techniques for avoiding striking through apart from careful adjustment of the viscosity of the latex mixture, fabric tension

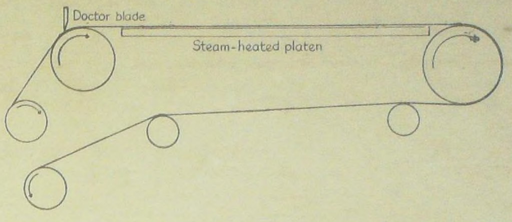

Fig. 2. Orthodox spreading machine with steam heated platen.

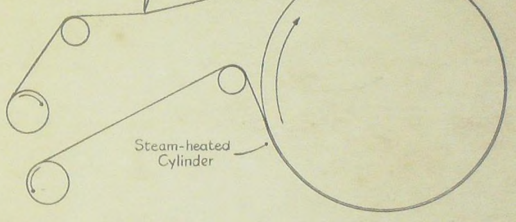

Fig. 3. Spreading machine with drum drying arrangement.

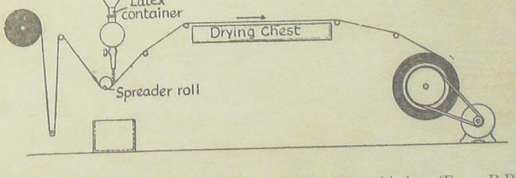

Fig. 4. Arrangement for spreading without doctor blade. (From B.P. 319726. Courtesy—the Controller, H.M. Stationery Office.)

and the pressure and angle of the doctor blade. Thickening of the latex with gums or substances such as methyl cellulose is advantageous.

Slight flocculation of the latex is claimed to be effective by the Anode Rubber Co. The essential principle in their method of preparing a flocculated latex is to add a coagulant such as acetic acid or zinc, magnesium or aluminium sulphate to a diluted latex containing a protective colloid such as casein, sodium aluminate, glue or gum acacia. One example consists of 400 parts of 5% latex mixed with 130 parts of 5% sodium silicate and 120 parts of 5% aluminium sulphate; the flocculant is concentrated to 18% rubber content by simple draining on a cloth and then compounded with vulcanizing ingredients (397997).

Another method is to cause rapid gelling of the latex film by the use of heat-sensitive latex or by treatment of the fabric with a coagulant. Additionally it is often desirable to avoid the serum and non-rubber constituents of latex liberated at the fabric surface travelling through the fabric and causing staining. Gelling of the latex rubber does not avoid this since serum is liberated. International Latex Processes incorporate in the latex a gum such as locust kernel, locust bean, carob, etc., and apply to the fabric a boron compound such as borax, sodium perborate or boric acid, which has a gelling action on the gum, and so holds the serum into the rubber film and prevents its penetration into the fabric (528435).

Yet another method of preventing striking through is the application of a fine spray which does not strike the fabric forcibly but drops on it as a fine rain to deposit particles and form a film on which one or more layers can subsequently be spread (516365).

A very interesting idea is the use of a froth or foam of latex which, even though the rubber content is low, has sufficient viscosity not to strike through, and in fact behaves very like a bank of dough. It does not creep under guides, for instance. The froth or foam is substantially broken on its passage under the spreading knife and is set by drying or coagulated by contact with a surface licked with a 10% solution of acetic acid. The (dry) ingredients of a typical foam are:

	Parts by weight
Rubber	100
Sulphur	2·5
Accelerator	0·5
Zinc Oxide	2
Igepon	0·5

(451622)

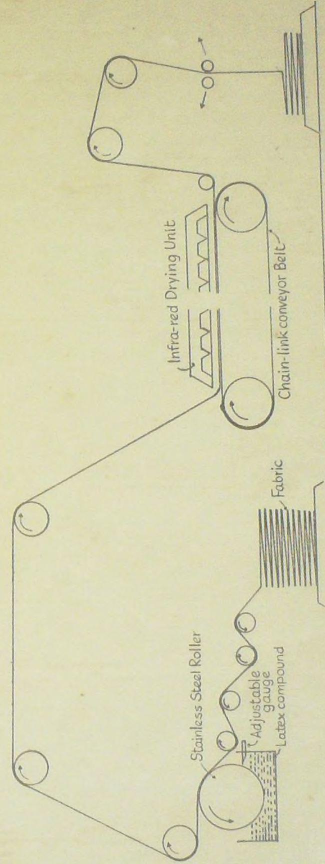

FIG. 5. The application of compounded rubber latex to fabrics by pick-up roller technique. (Diagram reproduced by permission of Rubber Latex Ltd.)

There is a great advantage in departing from the normal spreading procedure, and coating by the lick-roller technique. In other words, to form the latex film on a belt or roller and transfer it from that to the fabric by light contact. This method where only comparatively light coats are required, solves the problem of striking through and provides good control of the amount applied. A refinement is first to gel the latex on the roller or belt before it contacts the fabric to be coated (452176, 550073). (See Fig. 5.)

The most usual purpose of simple coating or spreading of fabrics is perhaps waterproofing, and the attempts at and suggestions for achieving this without the disadvantage of impermeability to air are numerous. Mixtures of wax dispersions and latex are commonly mentioned; the wax imparting water-repellancy to a latex coating applied so thinly that some degree of air permeability is maintained. For example, equal proportions of 10% latex and 10% carnauba wax, dispersed as follows are used:

	Parts by weight
Carnauba wax	100
Stearic acid	4
Glue	1·5
Water	1,000

Alternatively

	Parts by weight
Paraffin wax	60–65
Stearic acid	40–45
Ammonia (s.g. ·880)	30–35
Water	660–670

added to

40–60% latex	54
water	3,000

(448711, 481610).

The ability to apply a relatively thick coat with one spread of latex is at the basis of many suggestions to make elastic and/or air permeable fabrics, since mechanical manipulation to achieve special effects not obtainable with the multicoat-solution spreading is possible. By choice of fabric structure, e.g. one with raised or projecting yarn loops, local applications of latex are possible. These can fix the material in its normal or stretched form, and pressure can be applied to form local consolidation of the rubber film with resultant special effects. Reference may be made to the several patents of Chavannes and Schwartz to ascertain what may be achieved (443458, 471231, 482683, 482767, 482679, 482844, 495539, 496902, 498649).

At this point it is convenient to refer to combining, i.e. the cementing of two fabrics with latex as the jam in the sandwich. Combining with solutions is widely practised for the double-

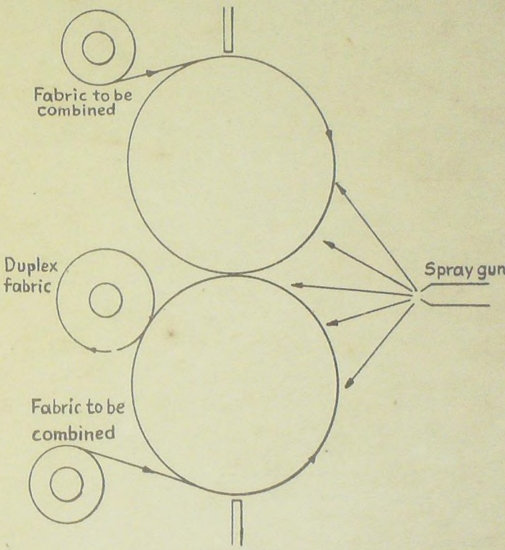

FIG. 6. Wet combining two fabrics using sprayed latex. (From B.P. 540475. Courtesy—the Controller, H.M. Stationery Office.)

texture waterproof. The process has been used replacing the solution by latex, and various devices have been adopted to maintain air-permeability of the combining film. (See Figs. 6 and 7.)

Spraying the latex lightly can achieve this; the actual combining being carried out by passage through the calender.

Puncturing the combined fabric to produce protuberances off which water will run and maintain waterproofness is also proposed (405970, 438891, 540469, 540475).

Spreading, coating, proofing are words which are used to describe the processes for the production of a continuous or nominally continuous film of rubber on the fabric. Impregnation must be taken to imply the filling of the interstices of the fabric.

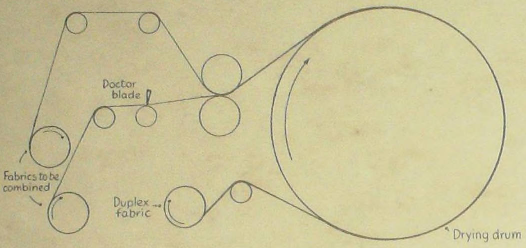

FIG. 7. Diagrammatic arrangement for the wet combining of two fabrics by means of a spread film of rubber latex.

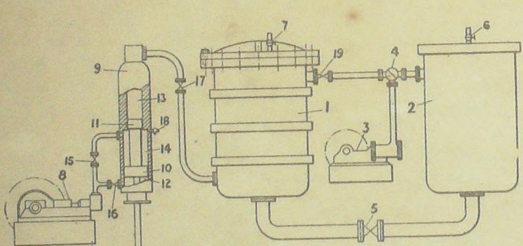

FIG. 8. Impregnation of textile material with rubber latex under pressure. (From B.P. 391031. Courtesy—the Controller, H.M. Stationery Office.)

The textile to be treated is contained in vessel 1, and the latex in vessel 2. Evacuation of the air in the former is carried out by the vacuum pump 3, with cocks 5, 17 and 7 closed and 19 open. Cock 19 is closed when there is a good vacuum in vessel 1 and cocks 6 and 5 opened, allowing the latex to flow in. Then, after closing cocks 5 and 15 and opening 16 and 18, pressure (up to 200 atmospheres) is applied by means of the pump 8. After the impregnation is complete, the excess latex is returned to vessel 2 by the use of the vacuum pump.

The phrase "interstices of the fabric" is not, however, clear since there are the spaces between the threads or yarns of which it is woven or knitted as well as the spaces between the fibres of which the threads or yarns are spun. In fact, in many cases the process used and also the fabric structure will determine how far complete impregnation occurs and how far only the between-threads interstices are filled.

Simple impregnation equipment consists of a trough with a roller under which the fabric passes, the excess latex being removed by doctor blades or squeeze rollers. (See Figs. 9 and 10.)

As already discussed, surface and interfacial tensions are important factors as is also the physical difference in the size of

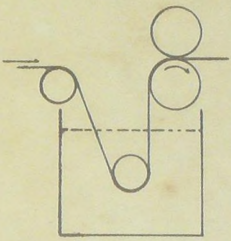

FIG. 9. Simple impregnation bath with squeeze rollers.

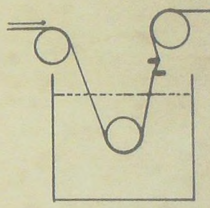

FIG. 10. Simple impregnation bath with scraper blades.

rubber particles and fabric interstices. Pressure is the obvious first answer and this can be indirect by vacuum or direct by air pressure or squeezing (316335, 391031, 494231). (See Fig. 8.) A more subtle method is to bend the fabric sharply so that the interstices on one side are opened to receive the latex; bending in the other direction completes the impregnation (413299). Yet another is to weave the fabric with cores in the form of binding threads which are easily removed to leave holes for the admission of the latex to aid impregnation (606513).

In Chapter II, immersion and entrainment processes are discussed and repetition is not desirable. In those cases where a rubber deposit is required within the fabric, the use of a dilute latex and some device to bring about coagulation is advocated.

Simple coagulants do not achieve much, but the use of an alkaline negatively charged latex on one side and an acid positively charged latex on the other side of the fabric is an interesting idea. The former is a normal latex, the latter is prepared by acidifying with dilute acetic acid a latex treated with ammonium caseinate; e.g. 25% rubber, 0·4% casein and 5% acetic acid in water (309391, 350106).

Coating or spreading of fabrics is required for waterproofing or bonding; impregnation may be required for the consolidation of a fabric for use as an artificial leather or for building into a composite article such as a tyre, belt or hose.

As an example of a specialized application, mention may be made of the treatment of hair-cloth, or substitute, with latex to reduce fraying and the shedding of hair, and to give a kinder feel with improved resilience (495264).

The addition of viscose to the latex used for impregnating or coating fabrics reduces the gas-permeability of the fabric. For example, 10 lb. of 33% latex plus 8 lb. of a viscose solution of varying cellulose content were applied to a cloth and dried at 70° C.; vulcanizing ingredients were added to vulcanize the rubber. The permeability was reduced as the cellulose content increased (214356, 350358).

Celulose content	Permeability at 100 gm/sq. m. in litres/day H_2 at 20° C.
0	16–18
5	8
10	5
15	1

The deposition principle to obtain impregnation was discussed in general terms in Chapter II and with more particular reference to yarns in Chapter III. Many of the remarks made and information given in the latter are applicable to fabrics of many types and also in the wearing-apparel industry to garments. In general it seems, however, that low-liquor ratios have to be used, and the analogy of a dyeing process where a bulk of material is handled in 10–30 times its volume of liquor does not apply to rubber deposition onto garments or fabrics. In the latter case, with Positex as well as other immersion-deposition processes, a padding process has to be used to saturate the material, removal of the excess exhausted liquor being carried out by gentle whizzing. Garments can be similarly padded or "drummed" at a low-liquor ratio of 2 or 3 to 1. "Drumming" involves placing the garments and liquor in a drum or barrel which is rotated gently to and fro until deposition has uniformly taken place.

Such processes are applicable to cotton and some of the synthetic fibres. There seems, however, little scope for the deposition methods as finishes for fabrics made of these fibres. It has already been emphasized that because these processes produce no rubbery feel they are particularly applicable to wool materials. The properties imparted are discussed in Chapter VI.

Chapter V

THE PROBLEM OF THE ADHESION OF RUBBER TO TEXTILES

THE main subject to be discussed in this chapter is, without a doubt, the use of latex in conjunction with other substances as a "dope" for the pre-treatment of fabrics and cords of synthetic fibres—in particular, nylon and rayon, to improve, or one might say bring about, their adhesion to subsequent spread coats of latex or rubber solutions.

As long as the rubber-textile composite products were based on cotton as the textile and dry rubber and rubber solutions for frictioning, topping and spreading, the problem of adhesion was a comparatively minor one. As already mentioned, the use of latex without suitable adjustment of its surface tension and/or treatment of the fabric presented a problem even with cotton because penetration and, therefore, mechanical locking, is less than with a rubber solution. The arrival of synthetic fibres changed the situation completely and reference must here be made to the painstaking and sustained effort over a number of years of the workers at the Research Association of British Rubber Manufacturers.[8] They have established that the fibre ends of the staple-fibred cotton contribute substantially to its superior adhesion to rubber, and the lack of such free ends in the case of the continuous filament rayon and nylon results in poor adhesion.

In the author's view it is possible that insufficient attention has been paid to the other differences between staple fibre and continuous filament cords and fabrics; e.g. in addition to differences in hairiness the structure in a staple-fibre material is such that passages exist along the fibres for the impregnant to enter the core of the yarn or cord from the outside. The fact that the staple fibre gives the better adhesion is confirmed by Lyons,[9] who reports a figure of 60% for the difference in the case of rayon. This worker also found that staple cotton had 25% better adhesion than staple rayon indicating other operative factors additional to the fibre ends. This is not the place to enter into a full discussion of the problem from this angle. Suffice it to say that the ultimate solution of the problem of obtaining good adhesion of rubber to rayon, nylon and other synthetic fibre-based cords and fabrics may well lie in the use of a proportion of staple fibre and the choice of a suitable weave. The position remains, however, that there are continuous filament products to be handled, and their use presents a problem of adhesion to be solved.

As already stated, whether the subsequent coating is to be applied from latex or solution, the use of water-based priming or bonding materials is widely used. The two commonest types are based on latex with a protein and with a phenol-formaldehyde resin respectively.

The mode of action in these cases is not clear. It may be that there is chemical reaction or specific adhesion involved between the fibre and the protein or resin which by reason of their rubber content adhere to subsequent coatings of rubber. Alternatively the function of the added material may be to stiffen the rubber, particularly at very low elongations, and provide a gradation in hardness from the fibre to the rubber coating with consequent distribution of stresses.

Latex-Protein Formulations

The most usual protein is casein, but hæmoglobin is also used. The technical literature and also the published patents contain several formulations and studies of their properties both in static and dynamic tests. Gardner and Williams [10] conclude as a general rule that the ratio of casein to rubber hydrocarbon should be 1 to 6 for optimum properties, and that the use of a reclaim dispersion with the latex in equal proportions is beneficial.

Heywood [11] favours hæmoglobin, also in the proportion of 1 to 6; i.e. rubber (as latex) 30; hæmoglobin 5; ammonia 3%, 1; preservative 0·05; and water 160. Total solids in the region of 20% are commonly recommended.

One of the early patents granted to Wingfoot Corporation compares the various proteins with a somewhat higher ratio, 2 to 5, and points to a 2- to 3-fold increase in adhesive bonding. Examples given are for a control rayon cord without any treatment at 8·2 lb./$\frac{3}{8}$-in. length, with latex alone 9·9, latex plus egg albumen 13·9, latex plus casein 17·3, latex plus blood albumen 18·3 (433777). A later patent by the same company pinpoints the use of a temperature of 120° F. for drying followed by 250° F. (449941).

The addition of carbon black to the latex-casein composition is recommended also (481079). On 100 parts of rubber (as latex with vulcanizing ingredients) 5–40 of casein and up to 40 of carbon, black is used; the black may be present in a dispersed reclaim rubber to be used with the latex.

The advisability of a heat treatment over and above that required to dry the material is also advocated by the Firestone Tyre & Rubber Co. This patent (546171) employs soya-bean protein 5 parts to latex rubber 12·5 parts, and shows a bond-strength increase of two-fold by the use of this adhesive dried at 100° C. and almost a four-fold increase when fully heat-treated at 135° C. for 1 hour. The mechanical handling of fabric in this process in such a way as to prevent streaking is also described (567423).

Latex-Resin Compositions

Protein and latex give satisfactory results as indicated by the data given above, and are somewhat cheaper; nevertheless, the phenol-formaldehyde-type resin with latex is very much favoured today.

It is safe to say that resorcinol is most commonly used as the phenol and the principle depends on the formation of the resin in alkaline aqueous solution, which is added to the latex where further resinification takes place.

A recipe given by the Dunlop Rubber Co. (507493) consists of resorcinol 12, 40% formalin 24, 10% caustic soda 12, 60% latex 120, water 1600. This in terms of solids is 1, 2, 0·1, and 6 for resorcinol, formalin, caustic soda and rubber. Other recipes give 1, 2, 0·1, 8–10 (577982, 577985).

The Koppers Co.[12] details the method of preparation as being carried out in the following steps. The resorcinol is added to 10 times its weight of water, and the formalin added with the caustic soda to bring the *p*H up to 9·0. The reaction is allowed to proceed for 2–4 hours with agitation. The latex is then added and the mixture matured for 12–16 hours before use. The total solid is reduced by dilution to improve storage life, gelation being a source of trouble if the *p*H is too high and the resin reaction has not been carried far enough.

As indicated above, the total solids of the dope as used for dipping are of the order of 5%, and it is usual to arrange for a pick-up of 5–10% of solids on the dry cord or fabric. Drying is carried out at 185–250° F. usually, although short periods at 300° F. are favoured. In any case the moisture content must be reduced to below 3% and the treated material stored in conditions of low humidity.

Other Processes

While the above two methods are the most widely used and well established there are a number of other ideas and suggestions of interest.

Dreyfus (521108) has proposed the use of latex with an unstable compound of cellulose. An example is 100 parts of viscose, (7–8% cellulose and 6–7% caustic soda) ripened to a salt number of 4–5, with 15–20 parts of 60% latex containing casein as stabilizer. After impregnation with this the rayon is passed through sulphuric acid and sodium bisulphite to regenerate the cellulose and coagulate the rubber; the material being subsequently washed and dried. In this way the rayon is rendered unitable to rubber subsequently applied.

Judged by flex-life, the use of low-molecular weight quaternary ammonium compounds containing alkyl radicals of less than 6 carbon atoms in latex results in improved adhesion, according to the U.S. Rubber Co. (559986). The quaternary ammonium compounds are not at all soap-like and are not in the cation active soap class. On the other hand, the value of cationic-soap treatment of cotton to improve adhesion to rubber has been discussed by Piccini.[13] He speaks of "positizing" the cotton by immersion in a dilute solution of a cationic soap. Furthermore, 10% of a special resin is added to the ordinary concentrated latex applied to the textile. The combination of the cationic-soap treatment of the cotton and the use of the resin gives high ply-separation loads.

There are a great many other methods proposed of achieving adhesion in which latex is not actually used. These employ special bonding agents or a chemical treatment of the fibre during or after manufacture. This is not the place in which to discuss these in detail, particularly as they are, indeed, mostly applicable to cords and fabrics to be subsequently coated by means of dry rubber or rubber solutions.

Method of Treatment

As a general rule, fabrics, weftless cord fabrics and cords are treated with the bonding dope by a simple entrainment-padding process and are dried by passage over steam-heated cylinders, drums or chests. Precautions are desirable to maintain constant tension so that the water does not upset the stress-strain characteristics of the fabric or cords.

Chapter VI

RUBBER-TEXTILE COMPOSITE PRODUCTS; RUBBER AS A FINISHING AGENT

So far in this booklet we have discussed the general principles with little reference to the products and the value of latex in the final products. In this chapter it is proposed to discuss the applications, although it will not be possible to go into great detail, and in many cases there is the economic factor as well as the practical points in the use of latex as alternative to dry rubber or dry-rubber solutions.

To consider the product that consumes most rubber, namely tyres of all types, here we have a case where the technique of manufacture is built round the dry-rubber processes of spreading, frictioning, calendering and extruding the components prior to building up. The rubber compounds in practically all instances are not replaceable by latex compounds. The use of latex is, in fact, restricted to the cord impregnation and/or surface treatment to improve adhesion.

Mention has been made of cord impregnation by the Filastic and Brandwood processes and also the idea of depositing rubber onto the fibres in the singles yarn which is subsequently made into the cabled cord. Evidence is overwhelming that the achievement of even a small distribution of rubber among the fibres of the cord or even between the individual threads that make up the cord produces a significant increase in fatigue life.

The advent of the synthetic fibre cord has accentuated the adhesion problem, and there are processes in regular use which employ latex in conjunction with a resin, as has been discussed in Chapter V.

As far as is known latex-proofed fabrics are not used in tyre construction, i.e. the use of latex has not extended beyond impregnation of cord to a limited extent and as an ingredient of the adhesive compositions used as dopes for the fabrics. The Firestone Co., however, have a patent describing the manufacture of a tyre from latex; the fabric is impregnated and subsequently coated by means of heat-sensitive latex; the tread is formed from a gelled latex (560893).

Many of the remarks made above apply equally to belting with the important exception that latex impregnation has been more widely adopted. Filastic and Brandwood yarns have found their main outlet in belting. Fatigue resistance to flexing is even more necessary in a belt than in tyres, and this has led to the development of improved methods of impregnation as already discussed. Another point concerns stretchability, and here latex can help in two ways: by binding the fibres of a yarn which has a lower twist than normal and therefore less stretch, and by assisting in fixing the cord or fabric in an extended position (403015, 526274). The pre-treatment of the material with acid or alkali to cause transverse swelling and longitudinal contraction may be combined with the latex treatment (443156). The technique of pre-stretching and treating with latex to fix the "stretch" is particularly applicable to belting made of knitted fabrics (586762, 586786).

Flexible hose in all sizes and for all purposes is made essentially of fabric with rubber lining and cover in many cases. Depending on the pressure it is required to carry, the precise construction varies; fabric wrapping, weaving and braiding onto the rubber are all common methods. In these, low-twist, rubber latex-treated cord or yarn may be used to achieve low stretch coupled with good fatigue life and adhesion to the rubber lining and cover. There is no need to repeat the facts here.

Flexible fabric hose of the fire-hose type in general relies upon the weave structure, the swelling of the fibres in water and the water-repellancy of their surface to maintain waterproofness. Rubber lining of the ordinary type produces a hose of unacceptable stiffness, but for various reasons an additional rubber proof is desirable.

There is an interesting series of patents granted to Lewis & Tylor Ltd., Geo. Angus & Co. Ltd. and F. S. Zabala describing the use of latex so as to improve ordinary woven fabric hose. Various methods of coating the inside of the tube with latex are adopted; rotating the entire hose and applying pressure is one, forcing a spreader, being a metal or wood-tapered plug, through the hose behind a quantity of the latex is another; compressed air may be used to drive the plug. By these means a thin uniform layer of rubber is formed on the inside of the hose. In another patent the weft yarn is treated with latex and is woven into the hose in a wet condition. In this way the latex fills the fabric interstices (453448, 547820, 547821, 551454, 558449, 553669, 564673, 540761).

From fabric hoses to fabric bags and containers in which commodities of all types are packed for transport and storage seems a logical sequence. The disadvantages of such bags are their porosity, tendency to rot and liability to contaminate the contents with the fibre of which they are made. No more ideal material can be imagined than rubber—flexible, binding, waterproofing—for the treatment of sacks and bags to overcome these disadvantages. It is no exaggeration to say that many workers for over thirty years have tried to increase the use of latex by this outlet. Practically speaking no progress has been made. Bags are cheap, made from cheap fibres and, relatively, rubber is very expensive. The buyer of the bag wants the cheapest obtainable, and no one of his customers, often remote, will pay more for the contents of the bag because the latter is a cleaner, better product. The extent of improvement is roughly proportional to the cost. At one end we can have a well-proofed material completely waterproof and free from shedding fibres; at the other end a very light spray coating of latex which does not waterproof the bag but locks the surface fibres so that they do not shed into the contents. Patents have been granted to Carlin (325020, 483381, 483393, 511613) for the application of latex to woolpacks, and one particular composition favoured is as follows:

Rubber (as latex) 2, clay 10, casein 1½, with addition of ammonia, formaldehyde and ammonium hydrosulphide.

In the treatment of textiles great care is as a rule taken to avoid any suggestion of stickiness and the applications where the self-adhesiveness of rubber finds use are few. One of interest is in surgical bandages, and reference is not here being made to the adhesive plaster, the adhesive layer of which is composed of rubber and resins applied from solvent solution. There is a non-adhesive but self-adhesive bandaging material which consists of a woven-cotton skrim impregnated or coated with unvulcanized latex. Several refinements of this basic idea appear in the patent literature; the dried film does not adhere to the skin or to instruments (442219, 449720, 498591).

The rendering of elastic-fabric bandages waterproof is far from easy, but low water absorption and high water repellancy can be obtained by treating the soft weft or warp yarn and/or the finished fabric with Positex and paraffin wax or more permanent hydrophobic substances such as Velan P.F. (545582).

Of the other non-clothing uses of textiles, pile fabrics, bonded fibrous structures, paper and artificial leathers are dealt with in separate chapters.

It remains now only to consider the very broad field of clothing, and here, if we dismiss the waterproof rubber-coated garments as having been fully dealt with, we have only to discuss the use of rubber as a finishing agent; that is to say, a material applied to the fabric or garment to impart a particular property without impairing any of the essentially textile characteristics such as air and moisture permeability, draping quality and flexibility.

It has to be accepted that rubber appears to be an undesirable additive for textiles for clothing. It is basically associated with waterproofness, impermeability and so forth. On the other hand, once it is realized that this characteristic of waterproofness only arises because a continuous film of rubber is applied to the fabric and, furthermore, that rubber can be added in other forms, then potentially its excellent binding qualities and flexibility make it desirable.

The fact remains that latex as a finishing agent has made very little progress for a number of reasons. Firstly, comparatively little effort has been made to make use of natural rubber latex in this way. Secondly, the advantages it confers are limited and are not easily commercially exploited.

Novelty effects are more readily adopted and accepted than such improvements as increased strength, longer wear, reduced fibre shedding and the like. Another difficulty is that rubber, generally speaking, is not a cheap material, and for success, latex requires some skill and experience in handling.

Two patents (441477, 486647) have been granted for the treatment of the toes and heels of socks and stockings with latex to increase their life and reduce or even eliminate darning. Both processes aim to ensure that the latex only partially coats the surface and does not clog the meshes of the fabric.[14]

The use of latex to finish silk stockings is considered in patents by The Naugatuck Chemical Co. (403121, 403394). Both processes apply the rubber by a deposition process from a dilute latex during the course of dyeing and include the steps of coagulating the rubber and washing out what does not adhere to the fabric, as already discussed in Chapter IV. The point to be considered here is the effect and properties imparted by the rubber. It is claimed that the feel is unaltered and the wear of the stocking is increased. The bursting strain of the fabric is increased and the tendency to run and ladder is reduced. The process can also be adapted to reduce lustre.

Other points to be made about this process are that the effects are achieved by very small amounts of rubber, and it is one of the first which uses rubber as a finish for clothing fabric in the textile sense.

Another patent of about the same date (431330) uses 5–10% of rubber applied from latex as a finish for cotton or artificial silk to obtain a crease-resisting fabric. The essential feature here appears to be the combination of relatively high proportions of sulphur with rubber by boiling the fabric in a bath containing the vulcanizing ingredients. Twenty-four per cent sulphur is the preferred amount on the rubber in the fabric, which takes $3\frac{1}{2}$ hours boiling to combine in the presence of 2% zinc oxide and 2% of accelerator. One can assume here that the high sulphur ensures that the rubber is hard and approaches in properties the resins which are known to impart crease-resistance.

The process of Gibbon, patented in the U.S.A. (U.S.P. 1890676), employs a bath composed of 1 lb. casein and 2 oz. of trisodium phosphate in 15 gal. of water and 5 gal. of 30% latex containing 2% sulphur and 2% piperidine pentamethylene dithiocarbamate (in the rubber). After impregnation and drying the material is washed in soap, to remove the non-rubber constituents, and redried.

Another process discussed in Chapter II is the Kolok process of Teague,[15] which is also a finish, and here socks and stockings are put forward as the most important applications for it. Improved wear, no harshness and shrink-resistance are claimed. Details of this process were published some two or three years after the papers and patents by Blow on the Positex process. (See Figs. 11 and 12.)

There is no doubt that, firstly, quite small quantities of rubber can be *deposited* onto textile material as a finish and, secondly, the handle is little, if at all, affected because the rubber is there as a deposit and not as a continuous film. Furthermore, when so applied improved wear, increased strength, fullness and, in the case of wool materials, shrink-resistance are obtained. The paper by Blow to the Society of Dyers and Colourists in 1938, and the pamphlets on the subject of Positex published by the B.R.D.B. in 1946–8 dealt in some detail with the properties conferred by small amounts of deposited rubber, and it is proposed not to repeat at length the content of these publications but to summarize and bring the information up-to-date as far as is possible.

The pamphlets attempted to cover a wide field and report preliminary findings on the effect of the rubber on a number of properties of the textile. In the case of non-wool materials most interest appeared likely to lie in the low-stretch yarns that can be

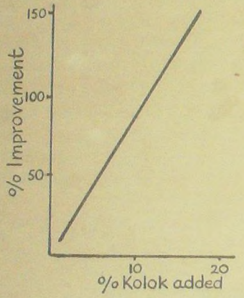

FIG. 11. Abrasion resistance of wool socks is improved by treatment with "Kolok". (From "The Kolok Process", M.C. Teague. Courtesy—India Rubber World, 1941, 104, No. 2, 42–43.)

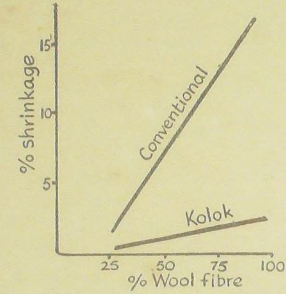

FIG. 12. Comparison of the shrinkage of mixture fabrics treated by conventional methods and by "Kolok". (From "The Kolok" Process, M. C. Teague. Courtesy—India Rubber World, 1941, 104, No. 2, 42–43.)

obtained by rubberizing a low-twist yarn. With short staple fibre such yarns would have inadequate strength without the rubber. In the light of further developments it does not appear that there is much application for rubber as a finishing agent for non-wool materials. The other applications in the mechanical-goods field have already been discussed.

The treatment of synthetic fibres such as rayon "Nylon" and "Terylene" is not so easy in the first place, and, furthermore, due to the smoothness of the fibre surface the binding quality of the rubber is not able to operate to the same extent as on wool. There will be occasions again later to refer to these fibres when consideration is given to the phenomenon of "pilling" and its prevention.

The increase in strength of certain wool yarns and fabrics has been demonstrated clearly from the data presented by Blow. The increase in wear is also proved. In the light of several years' development work, however, the importance of a rubber finish for wool material may well lie in the shrink-resistance qualities it imparts. This is not the place for a full discussion on the subject of shrink-resistant finishes for wool, but it is necessary to mention the methods currently used if only to emphasize the contrasting basic principle between them and the rubber-deposition method in achieving the result.

By reason of the scales on their surface the fibres are able, under certain environmental conditions and mechanical agitation, to move and migrate, and in so doing the yarn structure tends to disappear and a general compacting follows which is termed "felting". There are many methods in use which, by causing chemical modification of the scale-surface structure of the fibres, reduce their ability to migrate and felt. This treatment, essentially chemical, is generally accepted as reducing more or less the life of the material, but it is justified because the garments are wearable for a longer time than if they shrank out of all recognition.

In marked contrast to these chemical methods which produce their effect by removing the motive element—the scales—is the mechanical method in which the migration of the fibres is arrested by binding them together. The present author ventures to prophesy that this latter method will be the one that is eventually adopted by the industry, and it is significant how many patents have appeared in recent years claiming the use of synthetic polymeric and elastomeric substances to impart shrink-resistance to wool.

Extensive wearing trials carried out and reported by Rubber Technical Developments, Ltd., have shown how successful natural rubber applied as Positex is for this purpose. As has been pointed out in their reports, however, the results of corresponding laboratory tests do not correlate with the wearing trials. The laboratory tests have been devised when only chemical treatment methods of obtaining shrink-resistance were in use, and it is not surprising that the same correlation does not exist when a basically different method is employed. The facts seem definite, however; a batch of garments treated by a form of chlorination and tested in the laboratory for shrinkability in comparison with another batch treated with Positex showed little difference; garments from the same two batches subjected to actual wear and washing trials showed the rubber treatment to be decidedly superior.

The binding quality of the rubber imparts not only shrinkage-resistance of a high order but also less shedding of the short fibre lengths. The phenomenon, termed pilling, of wool materials of certain types and classes showing in wear the formation of small pills or balls of fibre on their surface is well known and of fairly common occurrence. The short fibres of the wool, when the twist in the yarn has been kept low for softness, migrate to the surface and there knot together. The rubber finishing agent prevents this unsightly defect, as is shown both by the photographs and the actual data of pills formed in such a machine as the Martindale Wear Tester, which incidentally was designed and developed at the Wool Industries Research Association originally to reproduce and measure the phenomenon in the laboratory.

Pilling can occur also in materials made of synthetic fibres, e.g. nylon, or of synthetic fibres in admixture with wool, and there may well be an application for the rubber treatment in these cases subject always to the proviso that deposition can be achieved and the rubber can obtain a grip of the smooth synthetic fibre.

The increased strength and improved life imparted has already been mentioned. Many scores of other trials have been carried out to ascertain whether or not rubber applied from Positex or other deposition process will impart a particular property or remove a troublesome defect. No better way of concluding these remarks can be suggested than to emphasize the importance of building a garment or fabric round the simple and basic property of this particular finish, i.e. the bonding of fibres together locally by means of a flexible material.

Before the subject is left, brief reference should be made to the fastness of the finish to normal textile processes. In general, once dried, the deposit is stable to scouring, milling, dyeing, laundering, pressing and the other normal processes to which wool is subjected.

The properties of rubberized wool as ageing of the rubber proceeds have been the subject of considerable study. It has been established that oxidation of the rubber, i.e. perishing or deterioration of the rubber to a resinous product, does not affect the essential property of the rubber in binding the fibres. The question of handle, however, is of primary importance, and under certain conditions, particularly in light, harshness may develop in material that is allowed to lie dormant for lengthy periods. The onset of harshness in material that is in service and constantly being flexed is less rapid and less marked. Moreover, it has been found that that portion of the rubber, viz., the oxidized rubber, which is responsible for the harshness is removed by soap and soda scour, so that ageing of the rubber does not render the fabric unserviceable. The loss of rubber which occurs during the later stages of the material's serviceable life is not so important since it is in the early stages, before matting and locking of the fibres has normally taken place, that the rubber is required to prevent fibre loss, etc.

The above paragraph is quoted from Positex Pamphlet No. 3 and probably represents a fair statement of the position. It is perhaps of interest to interpolate at this point some remarks on the part that the textile itself can play in the oxidation of the rubber. From many years of experience of applying rubber in small quantities as a finish to a wide variety of textile fibres, the writer has reached the conclusion that the ageing of rubber is not so rapid when present on a wool fibre as on a cotton or other cellulosic fibre. Unfortunately no data exists which can be used to prove the point scientifically, and this would undoubtedly be a useful subject for research. There are two analogous instances which lend circumstantial evidence to the conclusion expressed above. In the Mackey test [16] for the oxidizability of an oil a cotton "wool" is used on which to bring about the reaction; a wool material cannot be used in its place. In one of the methods devised to bring about the conversion of raw natural rubber to the oxidation product "Rubbone" cellulosic fibres are introduced into the rubber and very markedly catalyse the reaction; wool fibres similarly introduced do not have the same effect.

Chapter VII

LATEX TREATMENT OF PILE FABRICS

THE use of latex compositions in the manufacture and finishing of pile fabrics, in particular, carpets, has been developed commercially on several lines, and has for many years represented an important outlet for rubber. Firstly, mention may be made of its use as a partial or complete replacement of the normal-size backing which is always applied to carpets and rugs to increase the firmness and rigidity of the material. The advantages of rubber lie in its greater flexibility, waterproofness and binding property. A considerable measure of anti-slip, which is valuable in small carpets, mats and rugs, is also imparted by the rubber, and may be the main purpose of the treatment.

An early patent by Talbot (278785) was directed mainly at this advantage and claimed the use of latex in the glue-size mixture. The composition given is as follows:

Liquid latex	1 gal.
Water	1 gal.
Size, gluten, glue or gelatin	¾ lb.
Potassium chloride, glycerine or other hygroscopic substance	1 oz.
40% formalin solution	½ fl. oz.

Another recipe from a later patent (424158) used starch, and emphasizes the importance of ensuring that the starch granules are not burst or peptized to make the fullest use of the rubber.

	Dry weights	Wet weights
Rubber as 60% creamed concentrate	100	166
Stabilizer (saponin)	4	40
Raw tapioca starch	170	584
Vulcanizing ingredients		

It is more customary nowadays to use a compounded latex rather than an addition of latex to the normal sizing bath. In this case it is desirable to use a filled latex, e.g. compounded with clay and whiting, to obtain the necessary body and to impart rigidity to the finished carpet or rug. One difficulty that has to be guarded against is penetration of the latex through to the pile. For this Dunlop have suggested the use of a flocculated latex; the subject is frequently mentioned and has been referred to in Chapter IV (394487, 349141).

Hotchkiss [17] gives the following recipe for a carpet backing:

	Dry weights
Latex 60%	240
Karaya gum	4
Clay	200
Whiting	120
Zinc oxide	1·5
Sulphur	2·5
Z.D.C. accelerator	.1
M.B.T. accelerator	1·2
Antioxidant	1·2
Casein	4

The gum is added as a $2\frac{1}{2}\%$ solution dissolved in alcohol and diluted with water, and the other ingredients are dispersed with the aid of the casein and a small quantity of alkali.

If an unloaded mix is used, a relatively greater thickness is necessary, and Trobridge (410285) has proposed to apply a composition with a delayed-action coagulant or heat-sensitizing agent and gel it subsequently. The formula given is rubber (as latex) 100, sulphur 2, T.M.T. (accelerator) 1.

In general 1 to 4 oz. are applied per square yard according to the formulation used and the properties required.

The rubber may be applied by the methods of spreading discussed and illustrated in Chapter IV; spreading by doctor blade is widely used, and also by the lick-roller principle. (See Figs. 13 and 14.) The moisture is removed by evaporation over a steam-heated platen or rollers. If more than one coat is to be applied the time and temperature of drying must be such that vulcanization does not occur between coats. The vulcanization of the complete backing is carried out at the end.

A recent improvement on the simple spread coating is the application of a foamed latex to produce a sponge backing. Woolley (624113) achieves the same result by the use of a latex containing a blowing agent which is applied to the back of the carpet, dried and heated by infra-red lamps to decompose the blowing agent and vulcanize the rubber.

It was early realized that the binding action of the rubber in the base of pile tufts could be exploited to simplify the weaving process. The patent literature shows the development of this

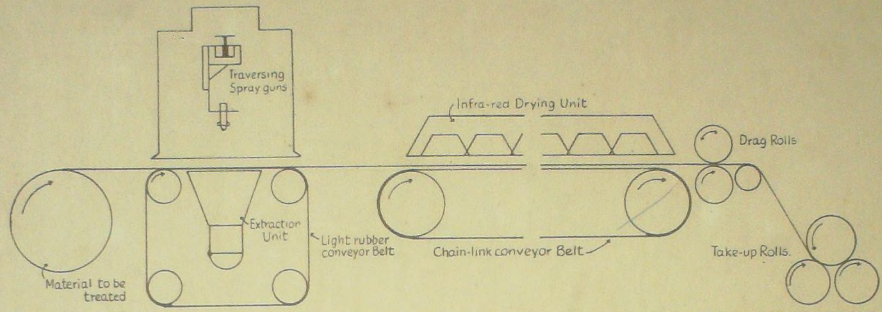

FIG. 13. The application of compounded rubber latex to the back of carpets, felt and other heavy textiles by means of spraying. (Diagram reproduced by permission of Rubber Latex Ltd.)

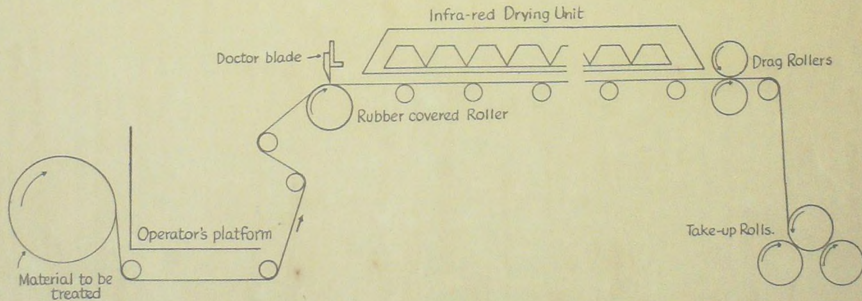

FIG. 14. The application of compounded rubber latex to the back of carpets, etc., by spreading, using infra red drying unit. (Diagram reproduced by permission of Rubber Latex Ltd.)

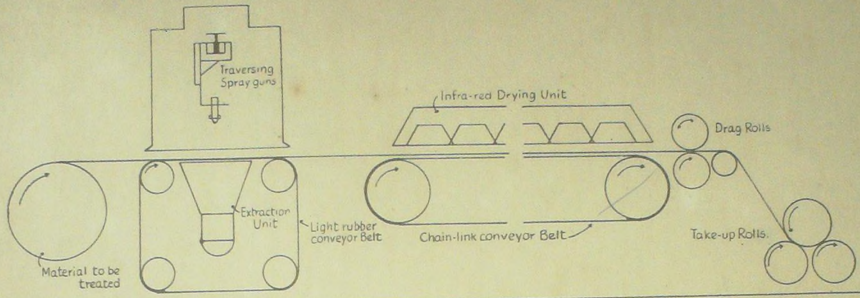

FIG. 13. The application of compounded rubber latex to the back of carpets, felt and other heavy textiles by means of spraying. (Diagram reproduced by permission of Rubber Latex Ltd.)

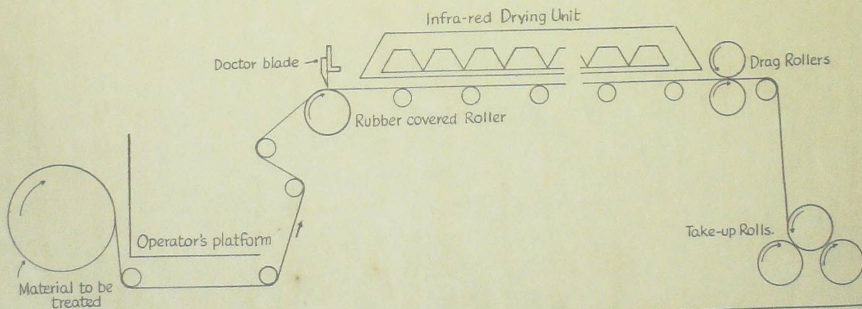

FIG. 14. The application of compounded rubber latex to the back of carpets, etc., by spreading, using infra red drying unit. (Diagram reproduced by permission of Rubber Latex Ltd.)

idea. Collins and Aikman, in particular, have five patents (333268, 336553, 369910, 484792, 484795), which deal with various modifications of the weave structure and methods of applying latex so that the exposed bases of the tufts are firmly rooted and there is imparted to the fabric sufficient strength to make good the deficiency resulting from the use of the subnormal number of threads. Moreover, the weave may be modified by the reduction of binding threads and the addition of more pile threads, so that a fabric is produced not only with the tufts more firmly held but also with a denser and more compact structure than is possible without the use of the latex binder. Yet another achievement is the double weave, whereby two fabrics are woven with the pile yarns forming the centre. Subsequently the two are divided by

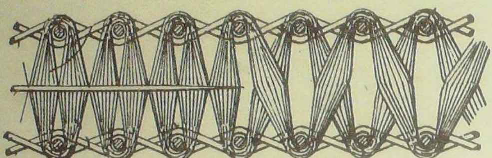

FIG. 15. Diagrammatic view of a double pile fabric being split; the use of latex to bind the tufts into the base threads enables a simplified weave to be used. (From B.P. 333268. Courtesy—the Controller, H.M. Stationery Office.)

cutting through the pile, and the tufts are secured by means of the latex. (See Fig. 15.) Fabrics based on these various constructions have been manufactured in the U.S.A. and the U.K. for a number of years.

The loom has still been used in these constructions, but during the past 15–20 years pile fabrics have been developed in which the normal weaving process has been eliminated. In many cases the pile is formed not from yarns but from carded web. The technicalities and mechanical devices are numerous and beyond the scope of this publication to describe in full. Angus [18] has described one process which has been used commercially for many years.

Carded fibre is formed into a thick web and forced between wires in a rotating drum. The backs of the closed tufts so formed are sprayed with an aqueous adhesive which is commonly latex, and a similarly coated hessian is brought into contact. Heat is applied to dry, bond and vulcanize the rubber. The loops are cut, and the pile fabric that results is cropped and finished. This carpet has the great advantage that it can be cut to any shape without fraying and therefore requires no binding, but so far the only use is by the motor trade. On the whole it lacks compactness.

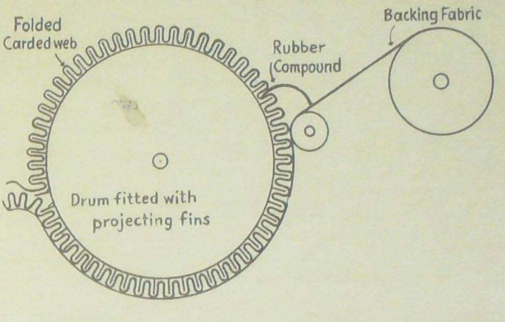

FIG. 16. Manufacture of pile fabric by cementing a folded carded web to a suitable backing cloth. (From B.P. 418012. Courtesy—the Controller, H.M. Stationery Office.)

Other processes have been described and illustrated in the patent specifications to which readers are referred. Great ingenuity has been shown in the mechanical devices for handling the yarn or web, folding and forming it into a loop and cementing it with latex to a backing of woven fabric; these being the three basic steps common to many suggested processes (406619, 418012, 472707, 557820, 670334, 674922). (See Fig. 16.)

Chapter VIII

LATEX-BONDED FIBROUS STRUCTURES

THIS title covers the very widespread use of rubber latex in one form or another as a binding material to lock or felt loose fibres of all types into structures of considerable strength and rigidity. According to the type of fibre, the form in which it is presented to the latex and the method of manufacture, so the density, strength, rigidity and resilience of the final product can be varied over a very wide range. It is, perhaps, convenient to consider one at a time some typical products and their applications. All the processes and products discussed in this chapter are essentially based on fibre in loose form, i.e. unspun and unwoven, and the first stage is to arrange it in an even layer or web either by hand spreading, garnetting, carding, aerodynamic carding, etc., in the dry state.

Bonded Hair for Upholstery and Other Purposes

The first series of products to be considered are those produced from hair or large-diameter fibre. The first patent in this field was granted to Weber in 1929 (341936), and was specifically related to upholstery fibres, horsehair, hogs' hair, algerian grass and coconut fibre. The preferred adhesive is rubber latex, which prevents the movement of one fibre relative to another. Very shortly afterwards, the first of a series of patents was granted to J. A. Howard, claiming improved methods of manufacture. Mechanical devices were dealt with in subsequent patents as well as specific applications and improvements related, for example, to incorporation of a spongy structure (355004, 408042, 431383, 446300, 448122, 468861, 479960). Other patents for the manufacture and use of resilient products consisting essentially of coarse fibres bonded by rubber latex have been granted to Talalay (489031, 646422), B. F. Goodrich Co. (403175), The Anode Rubber Co. (403375), M. Smith (420170), C. Weisleder (460120, 466990), F. S. I. Wernerson (464659) and E. O. Whiteley (521034).

The usual method of application of the latex is by spray and considerable ingenuity has been shown in their design and adjustment so that complete penetration of the mass of hair takes place. Some processes employ a dip in addition to the spraying.

One of the few descriptive articles dealing with this subject was published by Appleton [19] in 1947. This author claims that only animal hair can be used, as cellulosic fibres are not sufficiently resilient. There is no doubt that considerable efforts have been made to use the cheaper vegetable fibre, such as coconut fibre, sisal, straw and bagasse, and announcements are made from time to time of success—such as that made in 1941 by the Ford Motor Co.[20] that a suitable product for use in car seats had been developed from cactus fibre.

As a general rule the curling process applied to the hair before treatment is an essential part in giving the required properties. It is loaded into trays or moulds and sprayed with rubber latex. No wetting agent is used since it is desired to form blobs of rubber. Appleton gives the following formula for a suitable mix:

Rubber (as latex)	100
Sulphur	2
Zinc oxide	3
P.P.D.	0·5
M.B.T.	0·5
Antioxidant	1
Caustic soda	0·2
Dispersing agent	1·0
Casein	0·3
Water	7·6

After drying, the product is heated to vulcanize the rubber, usually at 100° C. for 45–75 minutes.

Modifications of the process include simultaneous latex treatment and formation of the pad, and the carding or garnetting of the fibre after rubberizing with the following composition:

	Dry	Wet
Rubber (as 10% latex)	5	50
Casein or glue solution	0·25	25
Gelatin solution	0·5	12·5
Starch solution	0·25	12·5

Yet another is the employment of a deposition process using a very dilute latex containing a delayed-action coagulant in which a loose mass of fibres is immersed (668842). For example, 1500 gm. of hogs' hair is placed in a vessel to occupy 200 litres. 180 litres of 2% latex with vulcanizing agents is added together with

100 gm. of sodium silicofluoride as delayed-action coagulant. The vessel is subjected to vibration until the serum becomes limpid when it is drained off and the fibrous mass, now coated with rubber, dried and vulcanized.

The patent granted to M. Smith (420170) is of interest in so far as it describes a process for spraying the fibres while they are falling or blown through an air space. As far as is known no

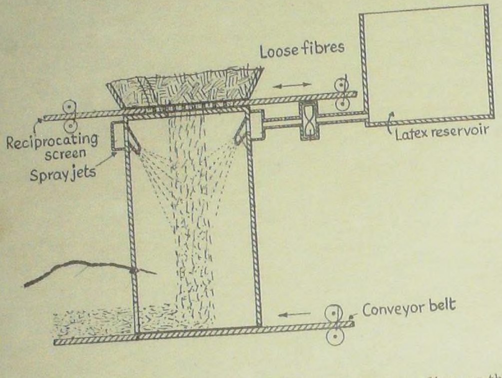

FIG. 17. Manufacture of upholstery pads by spraying loose fibres as they fall through an air space. (From B.P. 420170. Courtesy—the Controller, H.M. Stationery Office.)

commercial development of such a process has taken place. (See Fig. 17.)

The advantages of the rubberized hair lie in improved resilience, permanence of structure and low density (5 lb./cu. ft.). By far the most important use at present is in upholstery for the home, the car and the public vehicle. There is, however, an increasing use developing as a resilient packaging material for sensitive and valuable equipment. Other suggested uses include padding for saddles, boxing gloves and the like, and for sound and noise insulation.

The important fact to remember is that the resilience comes essentially from the fibres, the rubber serving to anchor the points of junction. Even when at low temperatures the rubber is leathery the pad remains flexible and resilient.

Bonded Fabrics

The second main class of products falling within the scope of this chapter is that now generally known as bonded fibre fabrics, bonded fabrics or unwoven fabrics. General articles on bonded fabrics have appeared during recent years.[21-25]

The basic principle of an unwoven fabric is, of course, not new. Felts may be unwoven and made from carded wool fibre subjected to the milling treatment, i.e. mechanical working in a wet or dry condition. At the other extreme there is paper, which in some senses may be considered a fabric. The manufacture of both felts and paper is limited, however; felts can only strictly be made from wool because only wool fibres have the property of felting; paper is limited by fibre length and swelling characteristics because fibres greater than a certain length cannot be dispersed in water for laying down the web, and fibres not capable of pulping will not interlock and matt to give a paper of any strength. In passing it may be remarked that progress has recently been made in the production of papers both from long fibres by the use of deflocculating agents (Koraya and locust-bean gums) and from fibres with only very limited swelling.[26]

For many years attempts have been made to bridge the gap between paper and true wool felts, using fibres longer than the paper-making fibres and non-wool. The needleloom felt, in which a web of non-felting fibres is mechanically interlocked via a fabric (hessian) backing or interlayer by means of a process in which blunt-ended needles are pushed into the material, is a well-established industry. During the past twenty-five years numerous processes have been developed for bonding fibres in a web so that their points of contact adhere and the material has strength and in many cases is still permeable to air and moisture.

The choice of bonding method lies between the use of a chemical agent which will attack the fibres of the web and cause their mutual adhesion, the use of a solvent or heat to make suitably chosen fibres adhere and the use of a non-fibrous extraneous adhesive or binder.

The first method is not widely used and is very limited in its application; the use of caustic alkali in conjunction with cotton is, however, an illustration. The second method has during the last few years become commercially important, both heat and solvent methods being used. The principle is to card a mixture of, say, cotton and a cellulose acetate fibre. The resultant web is treated with acetone so that the cellulose acetate is softened and on fusing forms an adhesive bonding agent for the cotton fibres.

Of the bonding agents used in the third method, synthetic resins, viscose and rubber have all received attention. For obvious reasons water solutions or dispersions are favoured. Printing with stripes or cross-lines of adhesive is a special case of the use of adhesive (693711).

Before passing on to discuss rubber-latex methods in detail, it is worth-while considering the preparation of the web for treat-

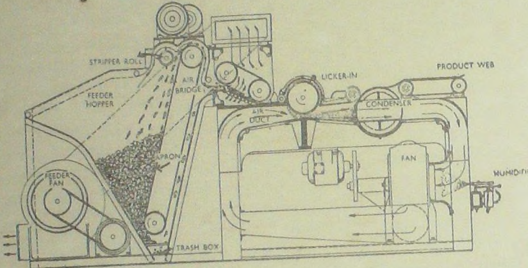

FIG. 18. The Rando-Webber machine and feeder for air-laying fibres. ("Bonded Fibre Fabrics", G. H. Elliott. Courtesy—Journal of the Textile Inst. **42,** 1951, 661–672.)

ment with the binder. Here again there are three methods: from liquid suspension; from air suspension; and by carding or garnetting.

The liquid-suspension method is essentially the paper-making technique which is severely limited by the fibre length, even though the natural binding of pulpable fibres, as in paper making, can be replaced by the adhesive. The reader is referred to Chapter X where the use of latex in paper is fully dealt with.

The great advantage of paper is the almost complete random orientation of fibres resulting in approximately equal strength and other properties in the two directions. Forming a web from an air suspension is, perhaps, for this reason a second choice, but, while randomization is achieved, evenness is not easy to attain. Machines are, however, now available, and the process is gaining in commercial importance. (See Fig. 18.) B.Ps. 659088 and 677928 describe devices for air-laying fibres.

The most widely used and the oldest method of web formation or preparation is carding or garnetting according to well-known textile processes. The choice of machine is determined by fibre type and length. The effect of the carding process is to disentangle the fibres and lay them parallel to one another, with the result that the web has markedly different properties in the two directions. This is disadvantageous from the point of view of bonded-fabric production, and efforts have been directed to mechanical methods of cross-laying the fibres. The basic principle for carrying this out was described in U.S.P. 909379 of 1909, to which readerc are referred.

It is not proposed to deal at any length with the textile techniques involved in obtaining the web or any bonding methods other than the use of rubber in latex form. The field is well covered by a large number of patents, the majority of which have expired. Some of these are in general terms aimed at establishing methods of treatment and handling; others describe methods of producing specific products such as upholstery padding, clothing stiffening, felts, artificial leather and so on. Commercially the various processes have not been developed very widely. Many applications and uses, in addition to those already mentioned, have been found or suggested, such as adhesive bandages, electrical and heat-insulation material.

Numerous inventors have realized the potentialities of taking a carded fibre and treating it with latex to produce a fabric-like material, and the detail they give and the ingenuity they show vary greatly. An early patent by the Rubber Latex Research Corporation (232763) specifically aims at "felting" smooth fibres by saturation of a web with latex, avoiding coagulation. The difficulty of completely wetting and penetrating the web is used to advantage to leave one side of the web untreated and therefore "fluffy" and of good handle. In contrast one can cite the process of Dewey and Almy (369474), which is a general method of producing a "fibre-reinforced rubber" or "rubbered felt", and uses a latex containing a delayed-action coagulant, e.g. Zinc ammonium chloride, or a heat-sensitive latex, so that after saturation coagulation can be brought about. Goldman (468529) lays claim to localized bonding, and discusses the mechanical arrangements for impregnation with various materials, including rubber. Klasi (498047) introduces the idea of latex as an assistant in the normal wet felting of wool fibres.

A series of patents granted to Sladdin includes one of the earliest references to "unwoven" fabrics (445930) and covers the impregnation of carded webs of both vegetable and "feltable" animal fibres with the following mixture: latex 66·26, gelatin 1·85, ammonia 2·45 and water 29·44. As an extension of the process the partially dried "fabric" is pressed and heated between dies to emboss it (461582, 470147).

J. and R. Pickles, who are among the few to have developed commercially the bonding of fibrous web with natural rubber latex, employ essentially waste vegetable fibre mainly of 2 mm. up to 10 mm. staple length with 20–50% of binder (latex) applied by spraying. The mass is consolidated and dried by hot pressing (567296).

Pads for clothing and upholstery form the subject of other patents (450689, 485705, 491840, 650936). These all consist of the same essential step of impregnating a mass of carded fibres. Talalay (491840) uses a foamed latex which is subsequently collapsed and set to bind the fibres. Chapman (450689) includes in his patent a description and a diagram of a simple useful contrivance for laying the web. (See Fig. 19.)

Another specific product in which bonded fabrics have found application is abrasive paper or cloth. The United Cotton Products Co. and the Carborundum Co. have several patents for the incorporation of abrasive particles with the fibre and bonding the whole with rubber latex. In some cases mechanical equipment is described at length (437526, 446853, 557038, 655540).

A needleloom felt to which reference has already been made requires a woven fabric into which the fibres are forced and locked and which provides rigidity to the final product. Kemp (653461) proposes to treat the needleloom felt with latex and then remove the fabric for re-use.

Reference may be made to the only patent the author has discovered relating to the bonding of feathers with latex (464529). The so-called featherdown felt is a structure of feathers or down held together by discrete particles of resin or rubber as adhesive at the crossing points of the fibres. Finely powdered resins such as colophony are suitable since they can be applied and fused by raising the temperature. Latex, as an atomized spray, can also be used successfully.

The greatest single outlet for bonded fabrics as revealed by patentees appears to be artificial leather, and many interesting ideas are to be found under this heading. Discussion in this chapter is confined to the production from carded fibrous materials; the reconstitution of leather wastes, the treatment of paper and the surface finishing of products are considered in Chapter IX and X.

Friedmann (535402) inclines to the view that ideally animal materials must be used to produce artificial leather, and suggests

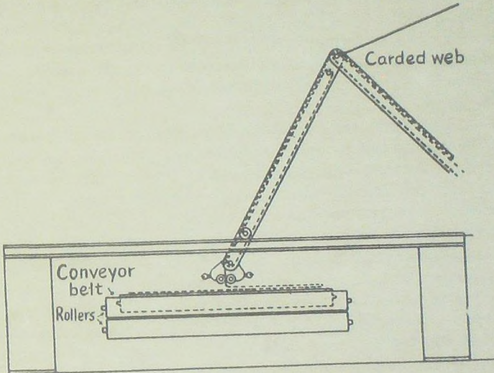

FIG. 19. Lapping device. The pivoted arm delivers the web or fleece from the carding machine onto a conveyor belt which moves transversely to the direction of the web so that the required thickness is formed and carried away by the rollers. (From B.P. 450689. Courtesy —the Controller, H.M. Stationery Office.)

the use of a mixture of milk 1 litre, gelatin 30 gm., potato starch 30 gm., latex 0·5 litre and water 1 litre for the treatment of "cotton wool", which presumably is carded cotton and hardly covered by his requirement for animal material. The patentee as a further step claims to tan the resulting leather with acetic acid 30 gm., tartaric acid 10 gm., borax 10 gm. and water 1 litre.

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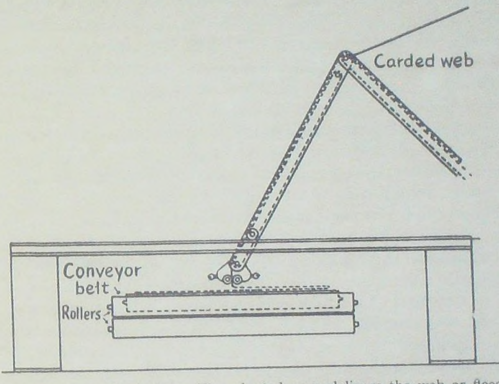

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Many of the patents in this group deal with the essentially difficult part of the process, namely the handling of the web in and out of impregnating baths, etc. Vereenigh Industrieal Bezet Veritex (439108, 474488) introduce into their description of the manufacture of artificial leather from carded cotton the step of lightly bonding the fibres together before the main impregnation using 38–60% latex with, in the second patent, 300–400% of fillers. Freudenberg's idea (505794, 522220) is to coat the *surface* of the carded fibre with the binder—latex—and combine two layers so that the untreated sides are outermost and can be subsequently impregnated. They also find that alkali treatment of the treated cotton gives the surface a pattern resembling leather.

Dressell in a series of allied patents (543779, 543781, 543785 and 543786) discusses in detail the various mechanical steps available to handle the webs. He considers, as alternatives, an agglutinant, muslin and wire-netting, and describes a device for holding and rotating metal frames containing the webs for impregnation.

In addition to the mechanical devices there are the preferred recipes for the various processes, and while cotton is mainly used, reference is also made to jute and other cheaper fibres. Bondy's recipe is: rubber latex 10 litres, rosin 10 gm., ammonia 200 c.c., aniline 100 c.c., phenol 5 gm. and water 800 c.c.; no concentrations are given for the rubber latex and ammonia. Pressing and drying a carded cotton or jute so treated yields an artificial leather (387136).

J. Votteler's (397741) recipe for a similar purpose is: 40% rubber latex 100 kg., water 40 litres, Nekal BX (wetting agent and stabilizer) 250 gm., paraffin oil in water emulsion 11 kg., coumarone resin 6 kg., precipitated with 45 gm./litre aluminium acetate.

Shiaiski (462783) obtains porosity in artificial leather produced by these or similar methods by adding magnesium carbonate to the latex impregnant for carded cotton, jute, etc., so that carbon dioxide is evolved during subsequent coagulation of the rubber by means of an acid.

There is no dearth of ideas both for methods of production and for use. In fact, there is undoubtedly a future for bonded fabrics because, firstly, a variety of products can be made and, secondly, all spinning, weaving and knitting are eliminated. This latter fact means not only saving of cost but also the possibility of using fibres which for one reason or another are not useable in the normal textile processes. The use of rubber is only one of several ways of bonding the fibres, and because of the relative cost factors it is important to exploit the advantages of rubber over other methods. While many workers have been attracted by the very obvious possibilities, most appear to have been disappointed at the results or overfaced by the mechanical and other practical handling difficulties for large-scale economic production. As already stated, commercial exploitation has been relatively limited. The author here ventures to suggest that there has been insufficient analysis of the problem as a whole and not enough clear thinking and study of the fundamentals of the situation. It is appreciated that the mechanical side predominates and determines success or failure, but the difficulties presented would have certainly been solved if the products were in fact attractive enough. One thing has waited on another. The following is, therefore, an attempt to discuss the problem in broad terms and logically.

The physical, and to some extent the chemical, character of the fibre will determine what we can do with a web of it—whether it be air-laid or carded—and also what sort of product will result from various treatments. Wool and animal fibres in general tend to show a high degree of recovery from a wet process, and the ordinary wool fabrics and felts are illustrations of this. In other words, we can wet-finish the loosest wool fabric and, provided conditions are not such as to cause the natural felting, the fullness will be almost completely recovered on drying. With cotton, jute and other vegetable fibres, including regenerated cellulose of various types, the result is very different. The loose apparently full fabric or web—such as cotton-wool—goes to a large extent dead and papery if it is thoroughly saturated and dried. In fact, of course, paper is the extreme member of a series of products, and, depending on the fibre length and resilience, cotton fabrics or webs after wetting and drying will resemble it in some ways. If, however, the fibres, when saturated, are bonded by means of rubber or other substances, then the resulting product will more nearly resemble paper.

Consider now a web of wool fibres. If this is treated, i.e. completely saturated with latex, and compressed and dried in that form, the product is certain to be of a papery character at a high content of rubber. As the rubber content is reduced, so the product will increase in fullness; in this respect it differs from cotton, because the wool fibres are resilient and tend to recover. The less rubber there is, the less the restraint to this recovery.

Furthermore, because the wool maintains a high proportion of its resilience when wet, if the rubber is deposited locally on the fibres when in a relatively large volume of liquor, the fullness of the product will be that much greater. The deposition processes have been discussed in full in Chapter II, and repetition here is unnecessary. It will suffice to emphasize their applicability to the production of bonded fabrics, not only using wool fibres where the advantage is greatest because of their resilience, but also using cotton, jute, rayon, etc., in which case less papery products are produced. It may be pointed out that there is no point in attempting to bond a wool web because it will felt in any case by suitable wet treatment. There are two answers to this. Firstly, the product of bonding is different in many ways from that of felting, as discussed later, and, secondly and more important, non-felting wools and hairs can be used with, if necessary, proportions of other fibres as cheapeners, the wool imparting the desirable properties referred to above.

The conclusion, therefore, is that, using rubber latex as a binder, bonded fabrics will be the more papery the less resilient the fibre is in the wet condition. The higher the rubber content, the more papery is the result, but if the rubber is deposited rather than coagulated or dried on, this effect is minimized.

A bonded fabric can never have the drape of a woven or knitted fabric because it is a web of fibres and not a structure of flexible threads with freedom of movement. The most that can be achieved is a "natural" felt in this respect, but, in fact, by choice of fibre and rubber content and using a deposition process a material more firm and compact can be produced. Such a product has uses in clothing, particularly if it also is permeable to air and moisture-absorbent.

As mentioned, many workers in this field have called the product of rubberizing cotton webs an artificial leather, but, in fact, it is not easy to strike the correct balance between strength and firmness on the paper side, and softness, fullness and resilience on the felt side. As discussed in the next chapter, many artificial leathers are made by surface coating papers of one kind or another, and certain bonded fabrics are superior to paper for this purpose. Deposition processes, unless simplifying mechanical processes, have no great advantage either in making the base for coating to an artificial leather or in producing an artificial leather which has merit without a finishing coating.

PLATES

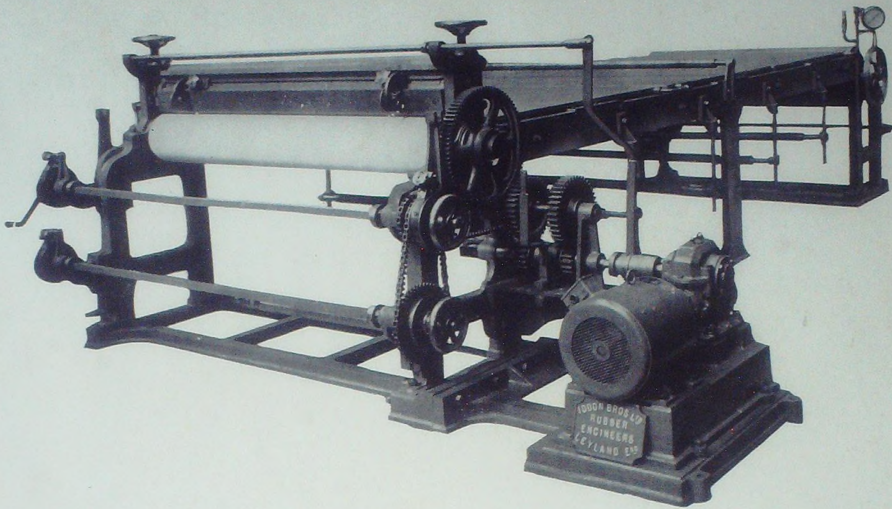


PLATE A. 72 in. wide by 15 ft. long motor-driven two-speed spreading machine. (Courtesy—Iddon Bros. Ltd.)

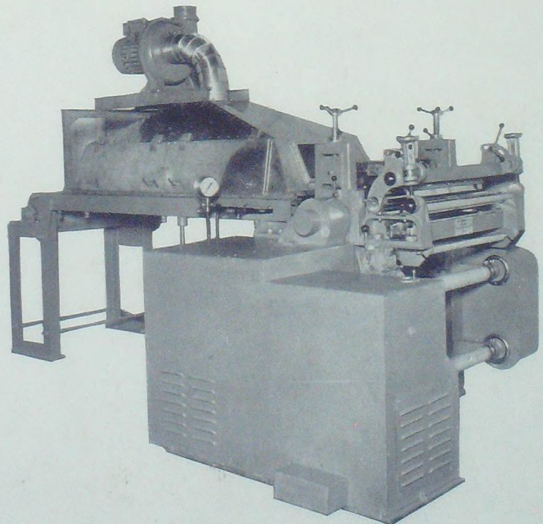


PLATE B. Long-chest-type spreading machine with latex head. (Courtesy —David Bridge & Co. Ltd.)

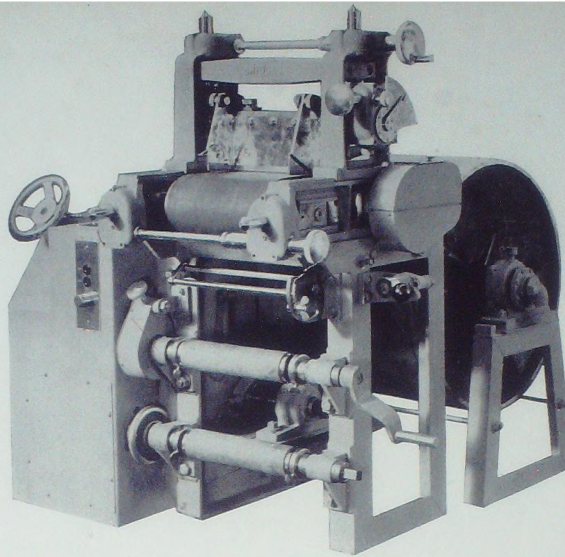


PLATE C. Wide-drum-type latex spreader. (Courtesy—David Bridge & Co. Ltd.)

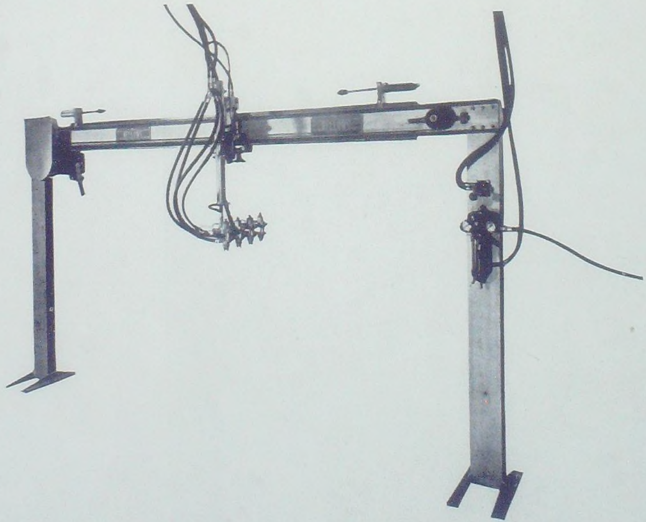


PLATE D. Four-gun automatic traversing spray equipment for latex.
(Courtesy—Alfred Bullows and Sons Ltd.)

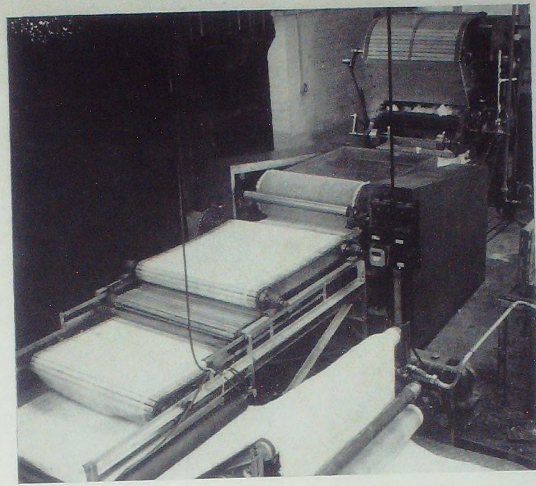


PLATE E. A view of the experimental equipment installed at Rubber Technical Developments, Ltd., for development work on the production of bonded fabrics using rubber as the binder.

PLATE E. Cord fabric for tyre manufacture being dipped in latex dope to

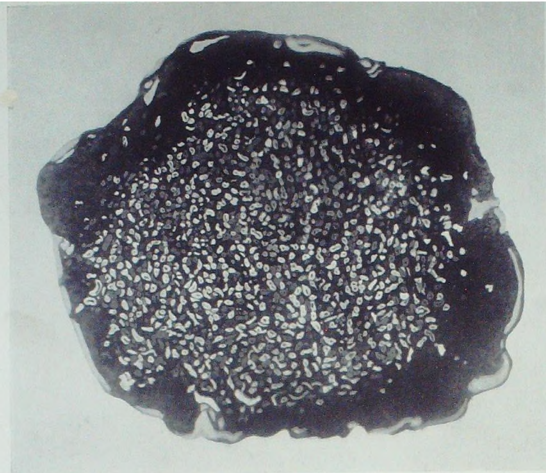


PLATE G. Photomicrograph of cross-section of Filastic Yarn. The cotton fibres appear as white dots or rings completely separated from one another by rubber. Surrounding the core of fibres is a thicker sheath of rubber which serves to insulate the yarns from one another.

The photomicrograph was produced by embedding a strand of the treated yarn in masticated rubber and heating in molten sulphur to convert it to vulcanite. The specimen was then cut and polished for photographing by reflected light. Acknowledgement to Messrs. Lewis and Tylor.

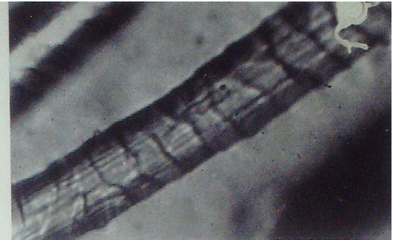


PLATE H. Alkaline normal (protein stabilised) latex with negatively charged particles with wool fibres also negatively charged—no deposition takes place.

PLATE I. Conditions also alkaline, but latex now stabilised with cationic soap and has positively charged particles—note the deposition of rubber taking place.

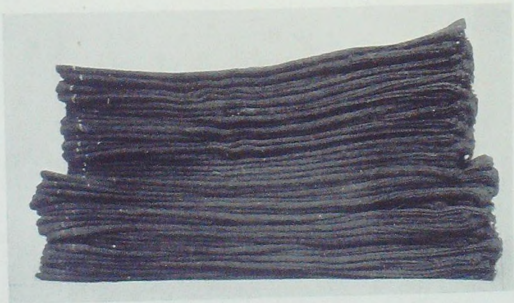


Plate J. Twenty pairs of socks returned after a wearing trial; those in the top pile were given a chemical treatment, those in the lower a rubber finish.

Plate K. Another demonstration of the shrink-resistance imparted by Positex treatment of wool socks.

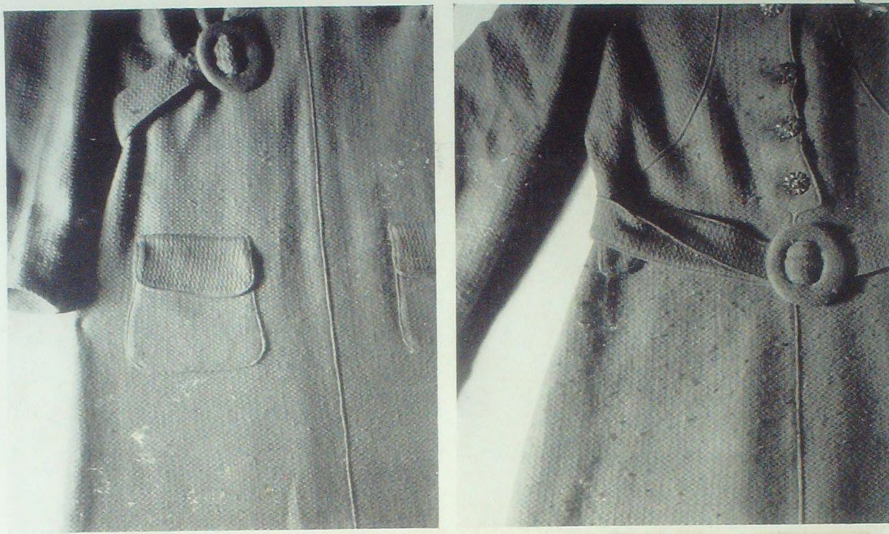


PLATE L. The practically complete elimination of pilling by the rubber finish is illustrated by these two fabrics worn for the same period of time by the same individual; the untreated one is on the [redacted] Right.-

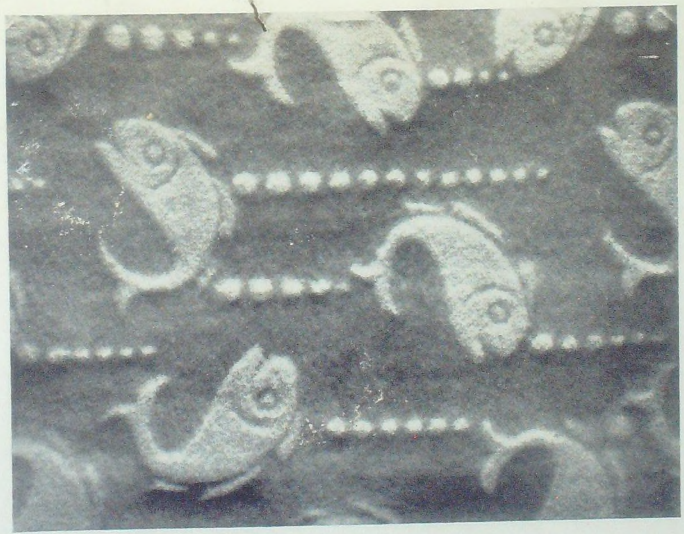
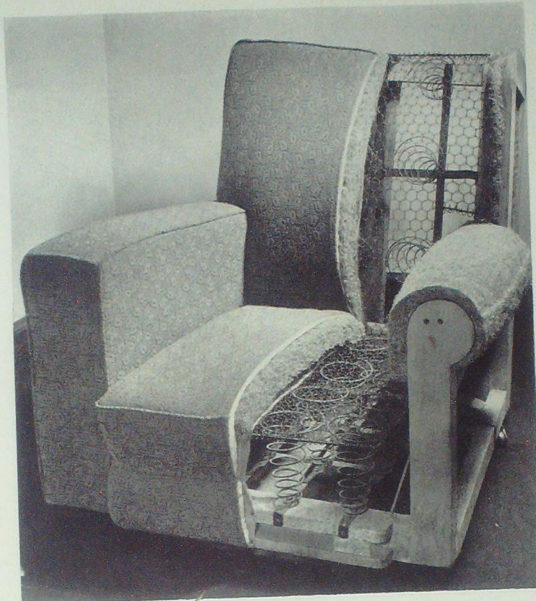


PLATE M. An illustration of the application of a rubber deposition to resist raising and obtain a novel embossed effect on a knitted wool fabric.



... of the application of bonded hair to upholstery.

This chapter would not be complete without reference to a somewhat different type of product which is nevertheless a bonded fabric. This is produced by treating a web of fibres in thin form under conditions where no saturation occurs, but only the deposition of fine droplets of dilute latex. In this way the web subsequently built up maintains its fullness, and only a very small amount of rubber is required. The resilience of the product is greater than that of the untreated web as judged by its recovery from compression, and due to the bonding it is mechanically more stable. Such a product is applicable to quilts, upholstery pads and the like, where this stability and resilience is advantageous and fibre migration needs to be avoided (644648).

Chapter IX

ARTIFICIAL LEATHER MANUFACTURE

In the last chapter the manufacture of an artificial leather of the bonded-fabric type was described. The essential character of the processes discussed in that chapter was the formation of a web of fibres by a dry process and the treatment of such an already formed fibrous structure with rubber in latex form.

In this chapter consideration is given to the other principal method of making an artificial leather using latex, which involves a wet process for forming the mat of fibres containing the binder, which becomes effective when the water is removed. In other words, the paper-making technique is used with or without the addition of the "pulp" of other fibrous materials. This is one of the most promising methods and has been successfully developed commercially by a number of firms in the U.K., Germany and the U.S.A. The addition of fairly high proportions of rubber to a suitable paper pulp takes the paper or board produced out of its class into something at least superficially resembling leather. This process is referred to in the next chapter.

One of the obvious methods to be tried to improve the product still further is to incorporate other fibres, in particular, ground-leather waste. The first step is the grinding of the leather waste, which requires care and skill. It is customary to disintegrate first in the dry state and to complete the grinding in water so as to produce a pulp which is handled by itself or in admixture with paper pulp. The ground-leather pulp has a high water absorption and gives a gelatinous material compared with paper pulp. Correspondingly it does not lose its water in the same way. Paper pulp is characterized by excellent filterability, ground leather is the reverse, and much greater suction or pressure has to be applied to obtain a "paper" with the required water content for calendering and final drying. Another characteristic of paper fibres which is also not found in leather waste is the natural interlocking to give strength. This means that a binder is essential to get anything like useful properties from a board made entirely of leather waste. It is obvious that a mixture of paper with the waste will improve both the filterability and the strength of the product.

There are a great many patents devoted to this method of producing artificial leather. Three early patents granted to Societa Invenzioni Brevetti (315413, 360017, 365564) use chrome tanned-leather waste and add latex, containing vulcanizing ingredients, to the extent of about 20% of dry rubber on dry leather. Neutralizing alkali is added as an essential step, and also tannins, which are claimed to aid deposition of the rubber onto the leather. Another early patent granted to Engel (342908) introduces an oxidation treatment of the leather by means of ozone first, the use of a stabilized latex and the addition of blown fish oil. Suction is used to drain off the water in what is essentially a hand process of manufacture.

International Latex Processes (429728) have a comprehensive patent defining in detail the conditions to be achieved and methods to be employed. It is pointed out that even dispersion and uniform bonding by the rubber must be obtained if lumps or clots of rubber and knots of leather are not to spoil the product. Attention to *p*H seems to be the key, and a range 4·3–7·8 is recommended. In an example, chrome-leather scrap is pulped to a content of 1–1·5 parts per 100 water at *p*H 5·6–6·5; a small amount of zinc chloride or aluminium sulphate is added to keep the *p*H down and increase the affinity of the leather for the rubber. Latex to give a rubber content of 30–50% on the dry leather is added. The use of an acid latex is included. Above a *p*H of 4·5 the rubber particles in this latex are still negatively charged, whereas the leather will probably be positively charged. The patentees have here established an important principle. The use of cellulose and tannins as additions to the above is also mentioned, and two earlier patents (422027, 422028) cover the addition of metallic oxides and carbon black as fillers to increase the strength of the final product, which is to be used for in-soles, upholstery and luggage.

Revertex (563213) flocculate the latex in the presence of fibrous material, and subsequently add a wetting agent or stabilizer. In this way the attraction of the fibres for the flocculated binder is increased, and its even distribution over the entire surface of the fibres is ensured. This use of a flocculated material with no charge and no tendency to coagulate is also referred to by Kemp (648331).

The aim is to develop a process that can run on a paper-making machine and be made in continuous lengths, at least to the stage of cutting into boards. In practice, slow filtration does not permit of this, and modification of standard machinery is necessary. The second difficulty, which is an ever-present risk with rubber, is damage to gauzes and felts. Hand making is therefore resorted to; that is, forced removal of water in a deckel and subsequent drying and calendering a sheet at a time. A novel way out of the difficulty has been suggested by Baur (447054). The latex-treated pulp is consolidated into a cylinder, and a continuous "sheet" peeled off by a coring machine.

So far leather waste with or without paper addition has been considered. It should be pointed out that asbestos has proved a useful fibre used either alone or with leather and paper. Dewey and Almy (377782) use a heat-sensitive latex in conjunction with asbestos. 1000 gm. of asbestos fibre is dispersed in 12 litres of water containing 15 gm. of haemoglobin; vulcanizing ingredients for the rubber in 5% haemoglobin solution are added; then 500 gm. of latex containing 150 gm. of dry rubber (i.e. 15% on the asbestos) diluted to one litre with water also containing 5 gm. of haemoglobin. A uniform dispersion is obtained with no coagulation, but at 65° C. coagulation occurs and the rubber is uniformly distributed around the fibres. Kemp's process (648331) uses asbestos also in conjunction with a flocculated latex obtained by mixing Positex and ordinary latex.

The treatment of a web with latex, the formation of a fibrous mat bonded with rubber by a wet process using paper, leather, asbestos, or a mixture of these materials, and the coating of paper and bonded or woven fabrics with a surface coat represents the three types of artificial leather. The last does not call for much comment since the leather-cloth and leatherette manufacturer uses lacquers made of resins or plastics as the finish. It is, however, common practice to use a latex undercoat to strengthen and seal a soft and absorbent paper or fabric.

For this a straight latex is, generally speaking, adequate, but the addition of polymerized acrylic-acid ester to certain coats has been suggested to improve the coating by obtaining a gradual transition to the final cellulose lacquer. For example (480834), the first coat may consist of a latex loaded with 250% of inert filler; the second coat of 60% latex 100, 25% polymerized acrylic-acid ester 200, and 10% cellulose methyl ether 40; and the third coat of 60% latex 100, 25% polymerized acrylic-acid ester 575, and 10% cellulose methyl ether 115; the final coat being the cellulose lacquer.

Another similar process in which the final lacquer is polyvinyl acetate (525440) lists the three coats as: firstly, 60% latex 24, 15% ammonium caseinate 15, pigment 24 dispersed in 15 of water with the aid of 35% ammonium caseinate 3; secondly, 60% latex 0·8, 15% ammonium caseinate 2, 40% formaldehyde 0·3, 30% P.V.A. emulsion 1·75; and finally, P.V.A. resin 2, benzol 8, pigment 0·4.

Chapter X

LATEX APPLICATIONS TO PAPER

THERE are important uses for rubber latex in connection with paper and, to some extent, for fibre-board made from the normal paper-making fibres. The application of the latex can be made at one of several stages during the course of manufacture, and all have been the subject of quite considerable investigation,[27, 28] although commercial development has not been as universal as might be expected.

Addition to Pulp

Taking the stages in logical order, the latex can be incorporated with the paper pulp when the latter is in dilute suspension prior to flowing onto the gauzes or felts for the paper manufacture. The original patent for the addition of latex to the pulp at the beater stage was taken out by Kaye in 1920, followed by several further patents during the succeeding years, and interest was revived again between the years 1927 and 1930 by certain modifications to Kaye's original process (167935, 191446, 210193). Basically, the idea is to add the latex to the pulp and bring about coagulation of the rubber particles in the presence of the pulp by the addition of alum, which is normally used in paper making to precipitate the rosin size. Efforts were directed mainly to the incorporation of quite small percentages at the rate of 3–5% of rubber on the dry pulp, but, even so, in practice many paper-makers found that the lumps of coagulated rubber which, by reason of the process of precipitation, tended to be of variable size adhered to the felts during the subsequent laying down of the paper web. Nevertheless, for many years prior to World War II, writing papers were produced containing this small proportion of rubber. One advantage claimed was resistance to creasing, increased strength and a particular handle or "rattle" which the rubber was supposed to give to the paper. Kaye's latex-paper process was extended to paper board, and the production of latex-containing boards for the shoe industry has been operated for a number of years. No detailed example is given by Kaye in his original patents, but up to 5% of rubber is claimed, and as little as 2% improves the bending resistance of the paper. In the manufacture of paper board, provided the rubber content is kept below 3%, it is understood that little difficulty is experienced in running the machines, and a decided improvement is given to the flexibility and resistance to cracking and bending. As indicated above, however, the simple coagulation of the latex in the presence of the pulp is inherently unsatisfactory as a process, because the size of the coagulated particles is uncontrolled and mutual precipitation of the rubber particles occurs rather than the uniform deposition or precipitation of the rubber onto the fibre. The addition of higher percentages of rubber presents many difficulties.

It was towards the improvement of this stage of the process that patents by the Mechanical Rubber Co., the General Rubber Co., and Ferretti were directed (295387, 356310, 375845). By control of the rate and order of addition of the coagulating agent and the use of protective colloids not only is greater control of the agglomeration of latex particles obtained but an actual deposition onto the fibre is claimed.

The inventors are, however, not agreed; the Mechanical Rubber Co. and the General Rubber Co. base their improvements on rendering the pulp alkaline, then adding latex followed by slow addition of coagulant such as alum or acid. The latter inventors add a protective colloid at an intermediate stage in the addition of coagulant to reduce the size of the latex-rubber agglomerates. Ferretti, on the other hand, claims that rubber covers the fibres if coagulant is added first, whereas if it is added after the latex, coarse coagulation and clotting occur.

An alternative approach to a solution of the problem is by the use of cationic soaps, which, by suitable control of *p*H, can give a positive charge to the fibre. When normal latex is added to such a dispersion of fibre, mutual precipitation of fibre and rubber takes place with the avoidance of coagulation and greater uniformity of the rubber deposit throughout the finished paper. It is by the use of such methods, whereby an affinity of rubber for fibre is involved, that higher proportions of rubber can be incorporated in the pulp at the beater or breast-box stage, and the normal working of the paper-making process is not interfered with. That is to say, the filtration is normal and rubber particles do not clog or spoil the gauze or felt surfaces.

It is of interest to note that this principle is adopted in patents granted to the American Cyanamid Co. wherein a cationic resin is applied to a pulp and subsequently a dispersion of latex, wax or synthetic resin is added whereby the latter is deposited on the fibres. Polystyrene and other synthetic plastics and not natural latex are referred to (637227, 654955).

The addition of small amounts of rubber does not alter materially the basic characteristics of the product, that is to say, that with up to 5% of rubber the product is essentially a paper or paper-board, but as the rubber content is increased, so the character of the product changes to what might be termed an artificial leather. The products are firm and yet very flexible and pliable and are finding increasing usage to replace leather in manufacture where conditions of abrasion are not severe, for example stiffeners, in-soles and slipper soles.

The processes so far described have been concerned primarily with the use of rubber latex in paper-making processes without any major modification of the technique. Put briefly, the pulp, having been adjusted for *p*H and protective-agent content and treated with the latex at the final stage, is passed over the machine as normal.

Treatment of the Wet or Dry Web

The second main technique for the use of rubber latex in paper is the treatment of the partially finished paper by impregnation. The problem in treating paper at this stage is that of securing penetration of the rubber into the interstices between the fibres. Natural latex particles having a diameter of about 2μ, are often large compared with the pore size of the paper and in alkaline medium will carry the same charge as the paper fibre. Penetration is thus difficult, and, in many cases, filtration occurs on the surface. This can be overcome by one of several devices. The wet web of paper can be passed through the bath of latex and subsequently squeezed to leave an amount of the binder in the paper, which is then finished in the usual way. Another alternative is to use a finished paper, but to choose the type, obtained by choice of fibre and method of manufacture, which is highly absorbent, so that penetration of the rubber particles can occur at least to some extent. A third alternative is to call to our aid latex with particles of reversed charge so that they are attracted into the fibrous mass with resultant improved penetration and deposition on the fibres.

Patents by K. L. Moses, E. I. Dupont de Nemours Co. and A. H. Stevens describe the impregnation of wet webs of paper-pulp stock, the aim being to obtain as complete saturation as possible. Kraft pulp is specifically referred to in the second of these, and an artificial leather is produced containing 20% of rubber (230994, 420836, 442002).

The main problem is the mechanical handling of the saturated pulp, and devices are described in patents by W. B. Westcott, the Dunlop Rubber Co. and R. Muller (234245, 397277, 403858).

The strengthening of unsized absorbent papers of various types is widely practised, using latex as the impregnant and binder for this process. Such impregnated and strengthened papers find use as base materials for application of surface coatings of nitro-cellulose and other synthetic lacquers, to give artificial leather cloths. They furthermore can form the basis for photographic (241769) and abrasive papers, for book and notebook covers, paper tape and twine, gaskets and a wide variety of uses where resistance to water, folding and tearing are required.

Special compounding of the latex is claimed by Portals Ltd. in the production of a strong, pliable water-impervious paper with high insulating value (387248). The impregnant applied to water-leaf paper is of the following composition:

> 10% rubber latex (ammoniated) 10 parts; boiled linseed oil 5 parts; 5% gelatin or casein solution 100 parts; sulphur and accelerators are dispersed in 2% formalin solution with which the impregnated paper is treated to harden the protein.

Admixture of latex with polyvinyl or polyacrylic resins and also with urea-formaldehyde resins form the subject of other patents by International Latex Processes, Ltd. and A. H. Stevens (535154, 577284).

Paper Coating

Finally, there is a third stage at which latex can play a part in paper making and paper finishing. Certain types of paper termed coated papers are given a high surface finish by means of clay and whiting dispersions bonded usually with some water-soluble ingredients such as dextrine and casein. Considerable development work has been carried out on the use of rubber latex, partially to replace the water-soluble binder, to give improved printing and folding properties and resistance to moisture to these coated papers (365466, 486197). The synthetic rubber and resin manufacturers have been most active in this field, but in many patent applications it is significant that natural rubber latex is included amongst the binders that can be used. The whole success of these latter applications depends on suitably stable latices for addition to the mineral filler, so that no difficulties are encountered in the standard spreading operations, which are, of course, carried out on high-speed machines.

The waterproof writing paper of Van Gils [29] is not without interest. The paper is first coated with the following composition after saturation with a wetting agent:

Creamed latex	100
Kaolin	15
Sulphur	1·5
Zinc oxide	1·5
Ultra-accelerator	0·5
10% Casein	5
5% Igepon	20
20% Paraffin wax emulsion	5

To make it possible to write on the paper it is then coated with:

Creamed latex	100
5% Igepon	30
Refined glass powder	30
1% Konnyaku meal	50

Chapter XI

MISCELLANEOUS PROCESSES AND APPLICATIONS INVOLVING LATEX AND TEXTILE MATERIALS

IN the foregoing chapters the various methods of application of latex and the uses and properties of the products have been discussed under general headings. In such a subject as that dealt with by this book there are inevitably a number of processes and products which do not fall into the classification and yet in their own sphere are important.

The Use of Rubber-Latex to attach Other Substances to the Textile Material

In the filling, dyeing and colouring or pigmenting of textile material, latex is applicable as the binder both for the added substance and to unite it with the textile fibre.

For example, farina filling of fabric is susceptible to water as normally applied, but according to Russell and Broomfield (217973) the following recipe:

		Parts by weight %
	farina	25
or	farina	20
	china clay	5
with	latex	3
	water	72

gives a filling which is impervious to water.

Insoluble pigments may be used to dye rayon if bound with latex. Two examples given by British Celanese (346511) are, firstly, the mixture of 25 c.c. per litre of 30% latex and 5 gm. per litre of ammonium cyanite to dye a cellulose acetate yarn by immersion at 75° C. for 1 hour. Secondly, at a liquor ratio of 50:1 graphite dispersion with 1 gm. per litre of ammonium cyanite and 55 c.c. per litre of 30% latex will pigment the yarn after three-quarters of an hour at 75° C. Lustre may be permanently reduced by a similar dispersion of zinc oxide bound with latex. In passing it may be mentioned that fabrics so treated have less tendency to run, slip, ladder or split.

Blow has proposed to apply pigments, insoluble dyes, waxes, metallic soaps, moth-proofing agents, insecticides and bactericides dispersed in cationic soap and mixed with cationic-soap-treated latex—Positex—to textile materials. The same deposition technique is achieved, and the rubber firmly binds the substances. Such deposits are fast to normal washing (638090).

Kingan, Phillips and Wilsdon have used latex to bind finely divided absorbent substances such as activated charcoal, bentonite or alumina to a textile to make a material suitable for antigas curtains or garments for decontamination workers (575379).

The ornamentation of fabric by attaching finely divided material to the surface of the fabric by means of latex is a logical sequence from the above techniques (580813).

The Use of Rubber Latex as a Resist to produce Novelty Effects

There appear to be possibilities not yet perhaps fully exploited to use rubber as a resist to treat local areas so that in subsequent processing those areas will appear different from the rest. The resistance of rubber-treated material to raising or brushing, because the rubber binds the fibres together, is one property that can be used, and has been described in Positex pamphlet No. 6. A fabric is printed with a design in Positex by the screen or roller technique, and the whole subjected to a raising process. The treated areas resist this, and the result is an embossed effect. For printing, a suitable paste has to be prepared from the latex by the use of thickening agents such as locust-bean gum or methyl cellulose. The rubber is fixed by drying off the fabric, and the thickener can be washed out in the usual way.

Combined with the resist to raising, pigmentation of the rubber can be used to give a contrast in shade. This general effect is particularly applicable to knitted fabrics with a plated thread designed for subsequent raising.

The resistance to shrinkage of rubber-treated material could also be exploited in an analogous way.

The Use of Latex as an Adhesive or Cement

No attempt can be made here to detail all the uses, applications and products involving textiles in which latex is employed as an adhesive. Many of the processes already discussed earlier fall into this category, e.g. the combining of two fabrics, the attaching of fibrous material to a backing, etc. There are, however, one or two processes which must be mentioned for the sake of completeness, and they are conveniently grouped under this heading.

What is commonly termed "flock spraying" uses, among other substances, rubber in latex form as the base coating or adhesive into which the short fibres or flock are embedded, sometimes by spraying, sometimes by spreading followed by a beating action. This type of finish may be applied to numerous surfaces including paper, fabric, bonded fabric and felt to give an imitation-suede effect (387451, 398580, 488080).

Apart from simple combining of two fabrics, latex has been used or suggested as an adhesive for reinforcing paper with fabric (479141), for cementing rope-like bands of jute material to make rope-soles for footwear without the necessity for stitching (546517, 561731) and for a compound fabric for printers' blankets where the rubber additionally provides a cushioning layer (481587).

Another type of compound fabric designed specifically for shock-absorbing, padding, cushioning and upholstering in furniture and its fittings is based on layers of pile or raised fabric secured together with latex (573344).

Special Application of Latex Coating

Dipping the ends of bootlaces, straps or belts in latex to prevent their fraying and to eliminate the use of metal tags is no more than a special application of latex coating (340173, 551740).

The coating of a mesh fabric with latex so as to provide webs or films of rubber across some or all of the openings provides a non-slip material for use with mats or rugs (522068).

Seaweed Insulating Materials

Seaweed is perhaps hardly a textile, but it has been proposed, firstly (440443), to bond undisintegrated or moderately disintegrated material in fibrous form with a stable latex such as "Revertex", to produce insulating building slabs. Secondly, digestion of seaweed with dilute caustic alkali followed by tanning produces a colloid which when mixed with latex and moulded or spread and lacquered is suitable for flooring, roofing and insulating material (371811).

The Applications of Latex to Asbestos

Asbestos presents a problem in so far as it contains much mineral matter or heavily charged material, which coagulates latex when it is brought into contact with it.

There is very little published information on this subject, probably in part because the additions of rubber to asbestos in general increases the organic inflammable or ignitable matter of the material and in consequence reduces its utility.

Dewey and Almy have three patents (377785, 399870, 399871) on the subject of rubber-bonded asbestos, covering in one case the use of a flocculated latex, obtained by first stabilizing with a protective agent such as casein and then adding a coagulant such as alum, and in the other case the use of an electropositive latex. This electropositive latex is prepared by acidifying a stabilized latex, e.g. 600 parts of a 35% latex are diluted with 3600 of water and 10 parts of haemoglobin. The acid—90 parts of concentrated hydrochloric acid—is then added.

It is stated that when this latex is added to a 10% slurry of asbestos fibres no coagulation takes place. After a time, however, the latex particles adhere to the asbestos, and the liquid clears. The product is handled on a paper-making machine, and the association of rubber and asbestos is intimate under these conditions.

Chapter XII

ABSTRACTS OF PATENTS

No. 167935. *Paper-making. F. Kaye.* (25.6.20)

Latex diluted to 0·1 to 1·0 per cent. of rubber is added to beaten paper pulp, the proportion of latex added being sufficient to produce a paper containing 0·5 to 5·0 per cent. of rubber on the weight of dried paper. After the latex and pulp have been thoroughly mixed, a coagulant is added in the minimum amount necessary to effect coagulation of the latex. The dried paper may be vulcanized by the Peachey process of cold vulcanization.

No. 178811. *Fabrications of rubber and filamentary materials. E. Hopkinson.* (15.3.22; *U.S.A.*, 22.4.21)

Tyre cords are treated with latex and then dried, a vulcanizing agent being incorporated in the latex or subsequently applied. Advantages of the use of latex for this purpose compared with the use of a solution of rubber in an organic solvent are indicated.

No. 191446. *Vulcanization of latex paper. F. Kaye.* (8.10.21)

Addition to No. 167935. A small quantity of a soluble alkaline sulphide is added to latex before the latex is diluted and mixed with paper pulp in the process described in No. 167935. Acid is added to coagulate the latex and to decompose the sulphide to provide sulphur to vulcanize the rubber.

No. 210193. *Moulded or pressed goods from fibrous materials. F. Kaye and Kaye's Rubber Latex Process, Ltd.* (7.11.22)

Fibrous material of animal, vegetable, or mineral origin, with or without filling substances such as china clay, is converted into pulp and treated with latex after or while being beaten in the beating engine of a paper-making machine. The rubber is coagulated on the beaten fibres, as described in No. 167935. Vulcanizing agents may be added and the treated pulp may be drained and moulded directly, but is preferably sheeted without complete drying and the sheet disintegrated and moulded under pressure.

No. 214356. *Treating fabrics with rubber compositions. H. P. Stevens and J. W. W. Dyer.* (31.1.23)

Latex is mixed with colloidally water-soluble cellulose or cellulose compounds, preferably viscose, and the composition is used for coating fabric. The product is suitable for use as balloon fabric, as it has a low permeability to gases.

No. 217973. *Filling, or dyeing and filling, of textile fabrics. R. Russell and H. Broomfield.* (20.3.23)

A small proportion of latex is added to the usual filling or dyeing and filling materials for application to fabric. The addition of the latex renders the filling resistant to moisture. In examples, latex is added to farina and to farina and china clay with and without pigments.

No. 230994. *Paper products. K. L. Moses.* (22.3.24)

A sheet or web of high porosity is formed from a liquid pulp of fibrous material on a paper-making machine, and the sheet is then impregnated with latex or rubber solution. The rubber renders the product resistant to tearing and surface abrasion.

No. 232763. *Batted or felted materials. S. G. S. Dicker, for Rubber Latex Research Corpn.* (7.4.24)

Smooth fibres such as cotton, flax, asbestos, etc., are batted together to form a felt and then immersed in latex under such conditions that clotting of the latex is prevented. The felt is removed from the latex and dried and is optionally vulcanized.

No. 234245. *Paper. S. G. S. Dicker, for Rubber Latex Research Corpn.* (7.4.24)

Paper is impregnated with diluted latex stabilised with ammonia, and the latex in the paper is gelled by drying.

No. 241769. *Treatment of felted materials and paper. Kodak, Ltd., and W. G. Bent.* (20.1.25)

Paper is coated with barytes or like substance to which latex has been added. The paper may subsequently be coated with photographic emulsion.

No. 278785. *Compound for preventing slipping of articles on polished surfaces. J. Talbot.* (6.7.26)

A composition for application to the backs of rugs and other articles to prevent them from slipping on polished surfaces consists of water, size (or gluten, glue, or gelatine), a hygroscopic chemical such as glycerine, latex, and formaldehyde.

No. 295387. *Leather substitute. Mechanical Rubber Co., assignees of R. P. Rose and A. F. Owen.* (2.8.28; *U.S.A.*, 11.8.27)

In making artificial leather, a pulp of fibre such as cotton is treated with latex and the latex is deposited on the fibres in minute particles by addition of aluminium sulphate. The pulp is formed into a wet sheet, which is cold-pressed, dried, and then hot-pressed.

No. 309391. *Articles of coated fabric. Dunlop Rubber Co., Ltd., and G. W. Trobridge.* (9.1.28)

In coating or impregnating fabric with rubber, the fabric is applied to a porous backing, as of porcelain, and coagulant is applied to the fabric or the backing or to both. Latex is then applied to the fabric. The manufacture of a rubber-coated fabric glove, rubber-coated fabric for tyres and waterproof fabric are described in examples.

No. 315304. *Dressing and smoothing yarns. J. Monforts.* (26.6.29; *Germany*, 11.7.28)

Yarns, cords, etc., of hard fibre such as manilla, sisal, etc., are treated with latex which is then dried or coagulated, and the treated yarn is rubbed, when dry, with talc or similar mineral powder. The process is a surface treatment only, as distinct from impregnation, and serves to hold down fibres projecting from the surface.

No. 315413. *Artificial leather. Societa Invenzioni Brevetti.* (8.7.29; *Italy*, 14.7.28)

Leather cuttings are pulped with a large amount of water, tannins are added, and then latex. The pulp is then placed on a perforated support and the liquid separated to leave a sheet, the separation of the liquid being carried out within an hour after the addition of the latex.

No. 316335. *Impregnation of permeable substances with latex. P. H. Head.* (29.3.28)

Permeable material such as fabric is introduced into a chamber in which a vacuum is created to withdraw air from the fabric and then stabilised latex is introduced into the chamber to impregnate the fabric. Impregnation of the fabric is completed by application of pressure.

No. 319726. *Methods and apparatus for coating fabrics. Naugatuck Chemical Co., assignees of J. McGavack.* (5.7.29; *U.S.A.*, 27.9.28)

In a process for coating fabrics or paper with rubber, the web is fed in spread condition and under tension under a spreader, and latex is caused to flow on to the web on the egress side of the spreader, the web being upwardly inclined at this point. The method permits a thick coating of latex to be applied in a single operation. Rubber sheet may be prepared by using a fabric impregnated with a coagulant, the rubber sheet being stripped from the fabric after drying.

No. 325020. *Wool-packs. P. Finlayson and W. W. Gunn.* (16.11.28)

Jute or hession fabric for use in making wool-packs is first treated under vacuum with a solution of silicate of soda and starch or like material, to which addition of latex and other specified materials is optional, and then subjected to pressure to consolidate it. A coating of vulcanizable compounded latex is then applied to the treated fabric. Wool-packs made from this material prevent contamination of the wool by jute or hession fibres from the pack.

No. 333268. *Pile fabric. A. J. Stephens, for Collins & Aikman Corpn.* (9.4.29)

The woven backing of a pile fabric having pile enmeshed in it is used as a matrix to position and hold the fibres of the pile while the tips of the fibres are embedded in a compounded latex adapted for solidification into a flexible backing, or fabric separable from the original backing, to form a new pile by splitting the pile between the backings. The operation may be carried on repeatedly until the pile becomes too short for further splitting.

No. 336553. *Pile fabric. A. J. Stephens, for Collins & Aikman Corpn.* (9.4.29)

A textile fabric having a backing and pile simultaneously fabricated comprises a body portion having a subnormal number of interwoven threads, based on the use to which the fabric is to be put, and a thin coating of an adherent composition on the back of the fabric to bind together the threads exposed on the back face and to provide the fabric with sufficient strength to compensate for the deficiency resulting from the use of the subnormal number of threads. The adherent composition is preferably compounded latex.

No. 337359. *Fibrous product. F. T. Lahey.* (19.6.29)

Fibres are cleaned and mordanted with ammonium sulphate or tannates prior to impregnation with latex. The latex-impregnated material may be used as a basis for artificial leather, tyre fabrics, floor coverings, etc.

No. 338381. *Spinning processes. L. S. M. Lejeune and J. E. C. Bongrand.* (25.11.29)

Fibres from which threads are to be formed are impregnated with elastic or plastic material when they are in the roving stage, the twist for converting the roving into thread being given to the roving after the impregnation. Latex is one material which may be used for the impregnation.

No. 340051. *Ropes. D. P. Frost and British Ropes, Ltd.* (29.1.30)

Ropes are impregnated with rubber by drawing through latex such a proportion of the yarns to be used that when these yarns are woven with untreated yarns, the resultant strands will be impregnated to the desired extent.

No. 340173. *Production of laces with soft rubber tags. A. Schoeler.* (27.2.30)

Boot laces are provided with rubber tags by introducing compounded latex into the end of a hollow lace and vulcanizing the latex in a mould.

No. 341936. *Resilient surfaces for seats, cushions, and upholstery. A. E. Weber.* (24.9.29)

Hair or other fibrous material is treated with a flexible adhesive, preferably latex, and then moulded into shaped pads for upholstery without being compressed. The latex is then vulcanized.

No. 342908. *Manufacture of artificial leather. A. Engel.* (13.2.30; *France*, 13.2.29)

Before or during trituration of leather scraps, the scraps are treated with an oxidising agent such as ozone. Stabilised latex is added in known manner to the pulp obtained from the scraps.

No. 344414. *Threads of textile material. J. E. C. Bongrand and L. S. M. Lejeune.* (25.11.29)

Threads of textile material are impregnated with latex or similar aqueous dispersion under fluid pressure, so that the elementary fibres are bound together and the constituent parts of a twisted or cabled thread are isolated from one another by the latex. An apparatus for carrying out the impregnation under increased or diminished pressure is described. The treated threads may be vulcanized or woven into fabric and vulcanized.

No. 346511. *Treatment of textile materials. British Celanese, Ltd.* (15.2.30; *U.S.A.*, 25.2.29)

Threads, fabrics, or garments of cellulose or cellulose derivatives are improved by treatment with latex, the tendency of fabrics to slip, ladder, or run being diminished thereby. The latex may contain suspended pigments or graphite and vat dyestuffs, and is applied as a paste. Vulcanizing agents may be included.

No. 349141. *Pile on tufted sheet fibrous material. Mechanical Rubber Co., assignees of B. H. Foster and K. B. Cook.* (28.2.30; *U.S.A.*, 7.3.29)

A pile fabric of the type comprising a base, and strands, cords, yarns, or rovings with free or looped-end portions forming the pile has the medial portions anchored to the base by a deposit *in situ* of an aqueous dispersion of rubber which does not substantially penetrate the base fabric. The strands may be introduced by needles and the base material may be a woven, knitted, or felted fabric. Preferably, a concentrated thickened latex containing a vulcanizing combination is used, applied by brushing, spraying, or spreading. The material is then dried and may be moderately heated. The tips of the loops may be cut.

No. 350106. *Manufacture of articles containing rubber. Dunlop Rubber Co., Ltd., Anode Rubber Co., Ltd., D. F. Twiss and R. G. James.* (31.3.30)

Semi-permeable materials such as fabric, parchment, and woven rubber are coated on both sides with rubber by deposition from aqueous dispersions of rubber, by applying to one side a dispersion having a pH value less than 7, preferably containing particles carrying electropositive charges, and to the other side an alkaline dispersion having a pH value of 7 or more. Deposition may be aided by electrophoretic means by introducing an anode into the acid dispersion, and a cathode into the alkaline dispersion.

No. 350358. *Impermeable cloth. Imperial Chemical Industries, Ltd.* (3.10.30; *U.S.A.*, 3.10.29)

Impermeable fabric for airships and balloons is made by coating fabric with a mixture of viscose and rubber, and regenerating the cellulose by exposing the coated material to an acid gas such as sulphur dioxide. In an example, glycerine is added to a viscose solution, then latex to make a mixture of 70 per cent. viscose and 30 per cent. rubber, with glycerine equal to 5 per cent. of the viscose. The fabric is first coated with a rubber composition, sized with gelatine or glue, then a number of coats of viscose-latex mixture are spread on, each coat being dried. The material is vulcanized by exposure to sulphur dioxide. The coated fabric may be used for diaphragms of gas meters, gas masks, gas-proof clothing, or boat sails.

No. 355004. *Upholstery pads. J. A. Howard.* (1.8.30)

A pad for upholstery consisting of a loosely intermingled moulded mass of fibres secured by a flexible adhesive such as latex is produced by moulding the fibres in the dry state and subsequently applying the adhesive by spraying or dipping and allowing the moulded mass to dry without compression.

No. 356310. *Production of paper and rubber combinations. L. Mellersh-Jackson, for General Rubber Co.* (11.6.30)

In the manufacture of latex paper by incorporating latex with the pulp in the beater, the rubber is deposited in finer particles and a more stable pulp mix is obtained by the addition of a protective colloid such as acetylated starch, glue, or casein to the partially beaten pulp in the proportion of 1–5 per cent. of the fibrous material present. The mixture is then made alkaline and the beating operation completed. The rubber dispersion containing 10–20 per cent. dry rubber is added and thoroughly mixed with the pulp. The coagulating solution is added in two operations or in one slow continuous operation to obtain fine deposits of rubber. With this process employing protective colloids, ordinary commercial rosin size may be added without premature coagulation or spottiness of the finished paper.

No. 360017. *Sheet material from fibres produced from hides or skins. Societa Invenzioni Brevetti Anonima-Torino, assignees of A. Mackay.* (29.7.30; *U.S.A.*, 29.11.29)

Two sheets of artificial leather made from leather scrap and latex are bonded together, during the course of manufacture, by means of latex or other adhesive and pressure between rolls.

No. 361398. *Impregnation of permeable substances with rubber latex. P. H. Head.* (23.7.30; 9.4.31)

A process for impregnating permeable substances as described in No. 316335 is modified by using a vulcanized latex, or vulcanizing after impregnation. Suitable vulcanizing agents for incorporation with the latex are ammonium polysulphide or colloidal sulphur combined with an accelerator such as diethylamine or zinc diethyldithiocarbamate. Vulcanization after impregnation is effected by spraying or painting with a liquid or gaseous vulcanizing agent. The process is stated to be suitable for the manufacture of textile driving belts.

No. 365466. *Protective coatings for paper. H. J. Prins.* (27.5.31)

Paper and paper containers are treated with latex and then with wax-like substances either molten, in solution, suspension, or emulsion, to form a waterproof coating. The first coating may be latex containing 40 per cent. rubber, which is partially dried and then treated with wax. The paper is then heated to a temperature equal to or exceeding the melting point of the wax, which dissolves in the rubber layer forming an elastic and impervious coating.

No. 365564. *Treatment of animal fibres. Societa Invenzioni Brevetti Anonima Torino.* (21.10.30; *U.S.A.*, 30.12.29)

Artificial leather is prepared from disintegrated scraps and cuttings of leather made into a pulp with water and treated with latex and a vulcanizing agent, while an accelerator soluble or dispersible in water may be added to the pulp before addition of the latex. The liquid is extracted immediately after addition of the latex, and coagulation is effected and vulcanization is started at this stage. The process is further characterised in that the slurry is drawn off and the vulcanizing ingredients and binder added to it continuously, as distinct from the batch method.

No. 369474. *Rubberized fibre articles. N. E. Brookes, for Dewey & Almy Chemical Co.* (30.5.31)

Fibre-reinforced rubber articles are made by impregnating a felt or fleece of fibres with latex containing a dormant coagulant, preferably ammoniated zinc chloride, and activating the dormant coagulant, for example by heat, to coagulate the latex. The latex may also contain vulcanizing agents and inert materials such as ground wood fibre. Salts of cadmium, magnesium, or calcium mixed with protective colloids such as casein and haemoglobin may be used as coagulants. When latex containing comminuted fibres is used, a product resembling suède leather is obtained by buffing the rubberized fibre surface.

No. 369910. *Coating fabrics. Collins & Aikman Corpn., assignees of A. W. Drobile.* (23.9.30; *U.S.A.*, 7.3.30)

In a method for coating and permeating fabric with a fluid, *e.g.* for coating the reverse side of a pile fabric to secure loosely attached pile threads, the fabric is passed beneath and in contact with a blade having a groove wherein the coating material is partially confined and given a swirling motion by the movement of the fabric, the forward edge of the groove not being in contact with the fabric. The fabric is supported during coating by means passing between the cut pile, for example, by rollers covered with card clothing. The method is particularly suitable for applying latex.

No. 371811. *Treating seaweed for manufacturing purposes. J. S. Campbell.* (24.11.30)

Seaweed is heated with caustic alkali, a tanning agent is added, and the heat treatment is continued to produce a gelatinous substance. When this substance has been dried, latex or dried rubber may be mixed with it, and the product may be moulded or dissolved in solvents and applied to fabrics.

No. 375845. *Manufacture of paper containing rubber. A. Ferretti.* (30.3.31; *Italy*, 31.3.30)

Coagulating agents are added to paper pulp prior to adding latex. Reference is directed to No. 237292.

No. 377782. *Treatment of fibres with latex. Dewey & Almy Chemical Co., assignees of W. B. Wescott.* (4.6.31; *U.S.A.*, 10.6.30)

In the addition of latex to fibres, such as asbestos, which tend to coagulate it, protective colloids are added in just sufficient quantity to stabilise the latex at about room temperature but which cease to prevent coagulation when the temperature is raised above approximately 65° C., and preferably to the boiling point. The protective colloids include sulphonated oil soaps, such as sulphonated castor oil soap or Turkey red oil, sodium silicate, casein, soaps, saponins, haemoglobin, serum, or egg albumen. Other fibres which may be treated include cords of tyre fabric, mordanted textile fibres, or fibres which have adsorbed finely divided material thereon.

No. 377785. *Rubber-bonded asbestos. Dewey & Almy Chemical Co., assignees of R. M. Day.* (9.6.31; *U.S.A.*, 10.6.30)

A rubber-bonded mass of asbestos fibres is made by heating a mutual aqueous dispersion of asbestos fibres and latex with a protective colloid, and, if desired, an additional potential coagulant, to a temperature above approximately 65° C., without agitation, thereby causing coagulation, and thereafter removing the water without changing, in one plane at least, the relative position of the fibres. The mass is then compacted.

No. 387136. *Production of leather substitutes. L. Boudy.* (18.2.32 *France*, 9.3.31)

A substitute for leather is made from a vegetable fibrous material such as cotton or jute, which is degreased, carded, and prepared in sheet form and then immersed in an aqueous solution containing latex, a resin such as colophony, ammonia, aniline, and phenol, after which it is washed, pressed, and dried. In a modification phenol is omitted from the bath, and the material is subsequently treated with dilute acetic acid.

No. 387248. *Manufacture of waterproof and insulating paper. J. Knaggs and Portals Ltd.* (2.8.32)

Paper is passed through a bath of emulsion comprising latex, boiled linseed oil, and gelatin solution, and after pressing between rollers is passed through a bath containing formaldehyde, colloidal sulphur, and an accelerator; again pressed, reeled, and allowed to remain wet for a period before being air-dried and calendered.

No. 387451. *Sheet material. Dunlop Rubber Co., Ltd., L. Brown, and F. W. Warren.* (25.11.31)

Sheet material having a pile-like surface and suitable for carpets, upholstery, etc., is made by applying disintegrated material such as cotton, wool, leather, cork, paper, asbestos, etc., to a latex foam sheet before the surface is set.

No. 391031. *Impregnating thick textile products with latex. J. Duarry-Serra.* (30.9.32; *Germany*, 13.1.32)

Thick textile products such as jute boot soles and ropes are impregnated with rubber by forcing latex into them at a pressure of 50–800 atmospheres. The latex is treated to increase its viscosity, and to stabilise it to reduce friction and prevent coagulation during impregnation.

No. 394487. *Production of pile or tufted fibrous material. Dunlop Rubber Co., Ltd., Anode Rubber Co., Ltd., E. W. Madge and E. A. Murphy.* (22.6.32)

Pile in carpets, rugs, and mats is anchored by coating the base of the carpet with a flocculent or granular precipitate which has been produced from latex. The precipitate may also be used to cement a backing to the woven material.

No. 397277. *Production of coated articles. Dunlop Rubber Co., Ltd., Anode Rubber Co., Ltd., and G. W. Trobridge.* (21.6.32)

Fibrous sheets, for example woven or knitted fabric, felt, papier mâché, cardboard, or compressed paper, are coated by applying latex or other aqueous dispersions of rubber by spreading, dipping, or spraying, superposing sheets of heat-conducting material such as aluminium which may be embossed or engraved, subjecting the whole to heat and pressure, and removing the heat-conducting sheets. Multi-coloured articles may be made by using dispersions of different colours, which may be spread on in streaks or sprayed through stencils. Alternatively one colour may be applied to the base and another to the heat-conducting material. A floor mat is made by coating felt with latex, superposing a smaller piece of aluminium matting having a pressed pattern, enclosing the whole between two plane sheets of aluminium, and subjecting to heat and pressure.

No. 397741. *Production of artificial leather. Julius Votteler's Nachfolger G.m.b.H.* (16.12.32; *Germany*, 19.12.31)

Artificial leather is made from fibrous materials such as fabrics, cotton wool, and wood or straw pulp by introducing the material into an impregnating medium such as latex between two strainer surfaces, squeezing between the strainers after removal from the impregnating medium by passing between rollers, removing the strainers, treating the impregnated material in a coagulant, for example aluminium acetate, and again squeezing and drying. A suitable latex contains a wetting agent, an aqueous paraffin emulsion, and finely powdered coumarone resin. Sulphur and accelerators may be added so that vulcanization takes place during drying.

No. 397997. *Production of goods of or containing rubber. Dunlop Rubber Co., Ltd., Anode Rubber Co., Ltd., E. A. Murphy and D. N. Simmons.* (21.6.32)

Fabrics are coated by spreading, brushing, or spraying with flocculent precipitates of rubber, obtained by coagulating largely diluted latex by means of acids such as acetic acid, salts such as zinc or magnesium sulphates, and metallic salts produced *in situ*, in presence or absence of substances having a restraining effect on the coagulation such as caustic potash, casein, sodium aluminate, glue, and gum acacia. The precipitate may be filtered, for example by ceramic material, cotton fabric, or wire gauze. Vulcanizing and compounding agents may be added to the latex or to the precipitate. The coated fabrics may be given a smooth matt finish by subsequent treatment with a mixture of a flocculent rubber precipitate and starch powder.

No. 398580. *Tennis balls. Dunlop Rubber Co., Ltd., and L. V. Kenward.* (26.4.32)

Short fibres, cork dust, wood floor or like material is adhered to the surface of a tennis ball by means of an adhesive which may be latex.

No. 399870. *Rubber-bonded asbestos products. Dewey & Almy, Ltd.* (15.4.32; *U.S.A.*, 17.4.31)

A latex in which the particles carry an electropositive charge is added to an asbestos slurry. The rubber particles remain of colloidal dimensions and attach themselves to the asbestos fibres, which remain dispersed. The charge on the rubber particles may be inverted to electropositive by strong mineral acids, when a protective agent, such as haemoglobin, is also employed; or preferably, by salts with polyvalent cations and monovalent anions, such as aluminium chloride or thorium nitrate, when no protective agent is necessary. The protective agent or the salt also assist in the dispersion of the asbestos.

No. 399871. *Products containing rubber-bonded fibres. Dewey & Almy, Ltd.* (15.4.32; *U.S.A.*, 17.4.31)

Latex, before being brought into contact with fibres which normally coagulate it, such as asbestos, is aggregated. This aggregation connotes the collection of the particles into larger particles whose size may range from 50 to 200 microns, or even larger. The aggregation may be carried out by the addition of definite amounts of hydrochloric acid, acetic acid, aluminium sulphate, sodium silicofluoride, zinc oxide, etc.; or an artificial dispersion may be made by redispersing rubber to the size required.

No. 403015. *Impregnated textile belting. A. Abrahamsen and J. E. Hansen.* (25.5.33)

In making transmission and conveyor belting by impregnating layers of fabric with latex, the fabric is stretched and the layers rolled together while the fabric is still moist. Manufacture is completed while the fabric is still under tension, so that the belt will not stretch in use.

No. 403121. *Treatment of knitted fabrics. Naugatuck Chemical Co., assignees of M. C. Teague.* (11.6.32; *U.S.A.*, 12.6.31)

In the treatment of knitted fabrics, such as silk stockings, with an aqueous dispersion of rubber, so that the deposited rubber is imperceptible to the sight and touch and the liability to run is reduced, the articles are treated in a scouring bath at a temperature not exceeding 212° F.; after which colouring agents are added together with an aqueous dispersion of rubber containing a relatively high proportion of casein or other protein. The bath is further heated to a temperature not exceeding 212° F. to fix the dye and to coagulate the rubber, the articles being then withdrawn, washed with water, extracted in a centrifugal machine, and placed on steam-heated metal forms which dry the articles and effect vulcanization.

No. 403175. *Cushioning bodies. B. F. Goodrich Co.* (12.8.32; *U.S.A.*, 18.8.31)

Cushioning material is made of flexible fibre such as horsehair maintained in thin open-mesh sheet form by an agglutinant such as latex uniting the fibres at their crossing portions. After drying, the sheet may be further coated with fibres after immersion in a bath of latex.

No. 403375. *Upholstery material made of rubberized fibres. Anode Rubber Co., Ltd., assignees of Magyar Ruggyantaarugyar R.-T.* (16.6.32; *Hungary*, 24.7.31)

In making shaped upholstery material by coating fibres with latex, the fibres are subjected to a preliminary treatment with liquids which wet the fibres and effect coagulation of the latex, preferably before the fibres are placed in the mould. After treatment with the coagulant and drying, the fibres may be loosened by carding, the loose condition being preserved by providing the wire-basket mould with horizontal and vertical wires or rods. The preliminary treatment may be effected with a single liquid, for example calcium chloride dissolved in a mixture of benzene and methyl alcohol; or two solutions may be used, for example benzene or an organic sulphonic acid followed by a solution of a coagulant.

No. 403394. *Treatment of silk stockings. Naugatuck Chemical Co., assignees of M. C. Teague and N. H. Brewster.* (11.6.32; *U.S.A.*, 16.10.31)

Divided out of No. 403121. In the treatment of silk stockings with latex, the stockings are first scoured in a soap solution heated to boiling and then the liquid removed and replaced by a dilute soap solution together with latex and a dye. Heating at 110° F. is continued until the dye is set, the latex being then coagulated by the addition at intervals of a 5-per cent. solution of potassium or ammonium alum.

No. 403858. *Artificial leather. R. Müller.* (1.5.33)

Artificial leather or imitation parchment is made by impregnating a preformed fleecy web of cellulose or wood pulp with latex on an endless metallic band, expressing surplus liquid if necessary, drying the impregnated web while still on the endless metallic band, and finally stripping the product from the band.

No. 404001. *Manufacture of ropes and cords. W. H. Wilkinson, D. P. Frost, F. Smith, and British Ropes, Ltd.* (28.6.32)

In making ropes and cords from fibrous organic materials, such as manilla, sisal, hemp and coir, the ropes or cords are impregnated with compounded latex, and the latex is coagulated by passage through a bath of dilute acetic acid or through a chamber containing formaldehyde, and finally vulcanized by heat or storage.

No. 405032. *Processes for facilitating the treatment of fibrous threads impregnated with rubber. J. E. C. Bongrand and L. S. M. Lejeune.* (29.7.32)

Divided out of No. 405312. Rubber-impregnated fibres are coated with a powder to facilitate after-treatment such as vulcanizing or weaving. The powder may be sulphur, zinc carbonate, zinc oxide, zinc salts of fatty acids, and the like. Zinc stearate with or without zinc oxide is preferred. This produces a slippery surface, and enables the threads to be woven, after which the rubber can be vulcanized if sulphur has been added to the impregnating solution, or the fibre has been mordanted with a vulcanizing agent prior to the impregnation.

No. 405311. *Processes for facilitating the penetration of latex into textile materials. L. S. M. Lejeune and J. E. C. Bongrand.* (29.7.32; *France*, 7.3.32)

The penetration of latex into textile materials is improved by adjusting the *p*H value of the textile or the latex, or both, so that both have substantially the same *p*H value; or in the case in which both are treated, the *p*H will become automatically adjusted to a value at which the latex will not coagulate. The process may be used in conjunction with those described in Nos. 338381 and 344414.

No. 405312. *Processes for facilitating the vulcanization of textile materials impregnated with rubber. J. E. C. Bongrand and L. S. M. Lejeune.* (29.7.32)

To facilitate the vulcanization of textile fibres and fabrics impregnated with latex, the material is mordanted prior to the impregnation with a vulcanizing agent, accelerator, or activator. The vulcanizing agent, etc., may be formed *in situ*, for example by soaking the textile in a solution of a sulphite followed by treatment with hydrogen sulphide, or a solution of a sulphide, to deposit sulphur; zinc carbonate may be formed by immersion in a bath of zinc sulphate followed by one of sodium carbonate. Vacuum or pressure may be employed to increase the penetration of the solutions.

No. 405313. *Impregnation of textile materials by latex. J. E. C. Bongrand and L. S. M. Lejeune.* (29.7.32)

In the impregnating of textiles with rubber, the textiles are wound on bobbins, soaked in latex, and kept in a humid atmosphere containing vapours of an anti-coagulant, the bobbins being rotated slowly to prevent drips from forming.

No. 405970. *Porous rubberized fabrics. P. H. Head.* (14.5.32)

Composite porous and elastic fabrics are made by spraying the surface of two or more pieces of fabric, preferably knitted, with a vulcanizing latex, placing the coated faces together, and uniting by pressure. The latex may be self-vulcanizing or vulcanizable by heat.

No. 406619. *Textile fabrics. R. F. McKay, for International Latex Processes, Ltd.* (25.10.33)

A pile fabric or rug is formed by applying an adhesive, such as latex, to one face of a layer of parallel fibres and bending and flexing the fibres in divers places to work the adhesive into the layer prior to vulcanizing. A fabric backing may be applied to the coated face of the layer and, if desired, to the untreated face, the structure formed by the latter treatment being subsequently cut to produce two pile fabrics that can be used separately or can be placed back to back to produce a double pile fabric.

No. 408042. *Manufacture of upholstery padding. Moulded Hair Co., Ltd., and J. A. Howard.* (4.11.32)

Lengths of upholstery padding of the kind described in No. 341936 are made by introducing the fibres into the upper end of a space between opposed, approximately parallel, downwardly travelling lengths of a pair of wide belts, a sheet of interlocked fibres emerging from the bottom of the space. Latex may be applied to the fibres before being fed into the machine or to the formed sheet, with or without previous treatment with a coagulant.

No. 408213. *Impregnation of fibres with rubber. U. Pestalozza and Societa Italiana Pirelli.* (30.9.32)

In the impregnation of yarn with latex, the yarn being treated is very slightly twisted only, and is in an untensioned condition. It is wetted to condition it for the latex impregnation by immersion in a hot solution of an alkali soap or of an ammonia soap.

No. 408931. *Impregnation of textile yarns and fibres with rubber. J. Brandwood.* (13.7.32)

Textile materials are impregnated with a rubber-containing liquid such as compounded latex by loosely winding on a foraminous holder, forcing the liquid between the windings, passing a compressed gas such as air between the windings, and subsequently drying and vulcanizing the wound package. Both the liquid and air may be passed through the material in opposite directions alternately.

No. 410116. *Manufacture of hose-pipes. L. S. M. Lejeune and J. E. C. Bongrand.* (9.11.32; *France*, 9.11.31)

Latex-treated yarns and threads prepared as described in Nos. 338381, 344414, and 405311–3 are used in the manufacture of rubber hose.

No. 410285. *Production of articles of fibrous material provided with a relatively thick backing of rubber. International Latex Processes, Ltd., and G. W. Trobridge.* (16.2.33)

Thick articles of fibrous material such as carpets, rugs, and mats are provided with a thick backing of rubber by introducing latex into a tray, bringing a surface of the article into contact with the latex while the free surface of the latex is uncoagulated or only semi-coagulated, and subsequently drying. The tray may be provided with a pressed, embossed, or engraved pattern and may be treated with a coagulant such as acetic acid before introduction of the latex.

No. 411460. *Rubberized and vulcanized fabrics. Filastic Ltd., for J. E. C. Bongrand and L. S. M. Lejeune.* (6.12.32)

Threads or yarns are impregnated with compounded latex while the latex is subjected to fluid pressure and the impregnated threads are then formed into articles. The articles are given a further treatment with compounded latex, the vulcanizing properties of this latex and the stress-strain properties of the rubber formed from it being the same as for the latex used for the initial impregnation.

No. 411887. *Manufacture of filter cloths.* *L. S. M. Lejeune and J. E. C. Bongrand.* (9.11.32; *France*, 9.11.31)

Filter cloth is woven from yarns or threads which have been immersed under pressure in latex, and the woven fabric is treated with latex containing vulcanizing agents or with chlorinated derivatives of rubber. After treating the fabric the excess material which closes the meshes may be removed by a blast of air. The fabric may be rendered porous by vulcanizing in the moist state or by adding to the latex material which will emit vapours or gases during vulcanization.

No. 411937. *Power-transmitting flexible couplings.* *L. S. M. Lejeune and J. E. C. Bongrand.* (21.12.32; *France*, 21.12.31)

Unwoven textile yarns or the like are immersed in latex to which pressure is subsequently applied and are then woven or laid so that they lie mainly in the direction of the stresses to be imposed on the coupling made from them. The woven or laid material is then further impregnated with latex, and the latex is coagulated and vulcanized.

No. 411938. *Manufacture of nets.* *L. S. M. Lejeune and J. E. C. Bongrand.* (21.12.32; *France*, 21.12.31)

An incompletely spun or twisted yarn is impregnated with latex under pressure, and then the spinning, twisting, and forming of the yarn into netting is carried out in the usual way. The process described in No. 344414 may be used, and the net may be subjected to a further treatment with latex.

No. 411939. *Manufacture of soles and heels.* *L. S. M. Lejeune and J. E. C. Bongrand.* (21.12.32; *France*, 21.12.31)

Yarns impregnated with latex by the process described in No. 344414 are formed into the shape of a sole or heel by cutting or moulding.

No. 412229. *Brake or clutch linings.* *L. S. M. Lejeune and J. E. C. Bongrand.* (21.12.32; *France*, 21.12.31)

Fibrous material is impregnated with latex by the process described in No. 344414, and the impregnated mass is then cut or moulded to the desired form for brake or clutch linings.

No. 412256. *Shock-absorbing and noise-absorbing materials.* *L. S. M. Lejeune and J. E. C. Bongrand.* (21.12.32; *France*, 21.12.31)

A shock-absorbing and noise-absorbing material is made by immersing textile fibres, yarns, or threads in latex under fluid pressure, for example as in No. 344414, forming the treated fibres, etc., with a sheet or band and then immersing the formed material in latex. A layer of rubber may be applied to one or both faces of the sheet material.

No. 413299. *Impregnation or treatment of textile materials with liquids.* *N. Lawson and Lewis & Tylor, Ltd.* (10.12.32)

Relatively thick woven textile materials such as those having a number of layers of weft are subjected to acute bending while in contact with latex. The apparatus for effecting the bending consists of a series of rollers of small radius, the cloth being passed over and under consecutive rollers while immersed in the latex. The method is intended particularly for the manufacture of belting.

No. 414692. *Manufacture of fireproof and waterproof fabrics and yarns.* *J. E. C. Bongrand and L. S. M. Lejeune.*

Mineral fibres such as asbestos, silica, glass and slag wool are subjected in a closed vessel first to the action of a vacuum and then to pressure, which may be pulsating, accompanied by circulation of latex. The product may be subsequently vulcanized. The fibres may be in the form of laps, felts, or yarns wound in bobbins, spools, hanks, or packets. An external coating of latex which may contain powdered asbestos may be applied by leading the impregnated yarn from the bobbin through a bath of latex and then vertically upwards, so that the added latex runs down the yarn to impart a smooth coating.

No. 416048. *Pneumatic tyres. J. E. C. Bongrand and L. S. M. Lejeune.* (7.2.33)

Textile material impregnated with latex by the process described in No. 344414 is assembled into a tyre carcass, the carcass is treated with further latex, and then the tread applied and the whole vulcanized.

No. 418012. *Composite pile fabrics. Dunlop Rubber Co., Ltd., and E. W. Madge.* (24.5.33; 26.3.34)

In making composite pile fabrics, a web of carded fibrous material folded by pins on a rotating drum is secured to a hessian or other fabric backing passing over a roller or doctor blade by a bank of adhesive maintained in a nip between the backing and the folded web. The adhesive may be latex and may be compounded. If thick adhesive layers are required, a coagulant may be applied to the folds of carded material or to the back, or to both.

No. 420170. *Manufacture of fibre upholstery pads. M. Smith.* (30.5.33)

In producing upholstery pads, fibres are caused to pass under gravity or by blowing or suction through an atmosphere charged with atomised particles of latex which act as an adhesive for the fibres. Short fibres about ½ inch long, such as cotton dust or hair waste from carding machines, are specified.

No. 420836. *Artificial leather. E. I. du Pont de Nemours & Co.* (9.6.33; *U.S.A.*, 9.6.32)

Artificial leather is made from an absorbent felt, prepared from a superficially mercerised and hydrated cellulose pulp, by impregnation with latex or other material.

No. 422027. *Artificial leather. International Latex Processes, Ltd., assignees of Societa Anonima Prodotti Salpa & Affini S.A.P.S.A.* (1.5.34; *Italy*, 18.5.33)

In the manufacture of artificial leather by mixing disintegrated scraps of leather with latex, there is added to the mixture one or more water-insoluble oxides or hydroxides of metals or metalloids belonging to groups higher than Group II of the Periodic Classification of the elements. Preferred compounds are the oxides and hydroxides of aluminium, silicon and titanium, the proportion added being about 5 to 15 per cent. or more on the weight of dry, disintegrated leather. The process can be applied to the processes described in Nos. 247089, 315413 and 365564.

No. 422028. *Artificial leather. International Latex Processes, Ltd., assignees of Societa Anonima Prodotti Salpa & Affini S.A.P.S.A.* (1.5.34; *Italy*, 18.5.33)

In the manufacture of artificial leather by mixing disintegrated scraps of leather with latex, carbon black (other than graphite) is added to the mixture in a proportion of 5 to 20 per cent. or more on the weight of the dry, disintegrated leather. The carbon black reinforces the material. The process may be applied to the processes described in Nos. 247089, 315413, 365564 and 422027.

No. 422960. *Improved textile elements. Société des Procédés Ecla, formerly known as Le Filastic, L. S. M. Lejeune and E. J. A. Lejeune.* (18.7.33; *France*, 5.4.33)

A textile element is obtained by assembling two or more rovings, each twisted in the same sense to such a degree that it can no longer readily be drawn out, and twisting the assembly in the opposite sense to such a degree that each roving is largely opened up. Such an element may be treated with acid or alkali and may then be impregnated with latex by brushing, or in a calendering machine, or by soaking. The latex contains vulcanizing agents. The impregnated materials are applicable for making ropes, cords, fabrics, webbing, transmission and conveyor belts, hose and brake tubings, tarpaulins, sacks, fishing nets, shoe-laces, card clothing, packings, brake blocks, pneumatic tyres, shoe soles, and flexible transmission couplings.

No. 424158. *Carpet materials. International Latex Processes, Ltd.* (11.7.34; *U.S.A.*, 1.9.33)

The backing of a carpet is coated with a mixture of latex and raw starch, vulcanising ingredients being preferably added to the mixture. In an example, 170 parts of raw tapioca starch were mixed with 100 parts of rubber as 60 per cent. latex which contained vulcanising ingredients.

No. 429728. *Leather-rubber material. International Latex Processes, Ltd.* (21.9.34; *U.S.A.*, 10.10.33)

Latex is added to an aqueous suspension of leather material, the *p*H of which is maintained below 7·8, and preferably between about 4·2 and 6·5. The affinity of the leather fibre for the latex globules may be increased by the addition of a relatively small amount of divalent or trivalent cation material such as zinc chloride, aluminium sulphate, alum, or the like, preferably added some little time before the addition of the latex to permit adsorption of the ions by the leather fibres. An acid latex having a *p*H above 4·5 may be used.

No. 430035. *Textile driving and conveyor belts. J. H. Fenner & Co., Ltd., and J. H. Fenner.* (16.12.33)

A belt, the whole structure of which is impregnated with rubber, is made by subjecting warp or weft threads, or both, to a vacuum for the removal of all air from the interstices of the threads and then immersing the threads in latex. The threads are woven into a belt, the belt is subjected to a vacuum, and then immersed in latex. The latex is preferably stabilised and should be compounded. The threads should be vulcanized before weaving, to overcome the difficulties of weaving tacky threads. The threads are preferably treated with a wetting agent to facilitate penetration and adhesion of the latex.

No. 431330. *Finishing of cotton and artificial silk fabrics. Manchester Dyers* (1914), *Ltd., and W. Watkins.* (4.11.33)

Fabric is treated with latex, dried out of contact with metals and then vulcanized in two stages, as follows: (1) by immersion in a bath of boiling water containing sulphur, accelerator and zinc oxide, rinsing and drying; and (2) continuing vulcanization in hot air. The purpose of the treatment is to make the fabric crease-resistant.

No. 431383. *Manufacture of upholstery padding. J. A. Howard.* (6.12.33; 12.2.34)

Hair or other upholstery padding is introduced between the upper ends of a downwardly extending stationary surface and another downwardly extending surface in such quantities as to fill the intervening space; and after issuing from the lower end of the space, the web of hair is treated with latex or vulcanized latex. A length of upholstery padding is thus formed.

No. 433777. *Treating artificial silk. Wingfoot Corpn.* (15.11.33; *U.S.A.*, 4.2.33)

A bonded composite material consists of artificial silk to which a mixture of a protein and latex has been applied and rubber bonded to the treated artificial silk. Casein is the preferred protein, but glue, albumen, gelatin, or haemoglobin may be used.

No. 435395. *Textile yarns and threads having latex incorporated therein. J. Brandwood.* (16.3.34; 27.2.35)

Textile yarns for the manufacture of tyre fabrics and belting are made by impregnating yarns with latex under pressure. After impregnation, the surface of the yarn is cleared of latex by treatment with a gas under pressure. The yarn so prepared has a smooth, frictionless surface.

No. 437286. *Rubber articles containing textile materials. J. E. C. Bongrand.* (26.4.34; *France*, 26.4.33)

A linear element is made from threads impregnated with latex and arranged so that deformation of the linear element is obtained by the threads pivoting relatively to one another about a fixed point, as opposed to the threads sliding one over the other. The elements may be used in textile-reinforced rubber articles such as tyres, hose, and elastic fabric.

No. 437526. *Agglutinated fibrous sheet material. United Cotton Products Co.* (4.5.34; *U.S.A.*, 29.5.33)

In an unfelted multilap web of fibres connected together with latex, the fibres of the various laps extend in a multiplicity of different directions and planes, and are interwoven and interengaged throughout the web. The product is particularly suitable for use as masking tape.

No. 438891. *Air-porous waterproof fabrics. C. J. Healey and Dux Chemical Solutions Co., Ltd.* (18.5.34)

The invention is applied to fabrics coated on one or both sides with rubber, or in which two fabrics are cemented together with latex or other adhesive. Such materials are rendered air-porous by being pierced with holes from one side only, so that the fabric is raised on the other side, which is the one intended to come in contact with the water; each hole is therefore at the top of a portion raised above the surface of the fabric. The water will run off the conical protuberances, and if the material is used as a ground-sheet, the holes on that part of the fabric on which the body rests will be sealed by the flattening of the protuberances.

No. 439108. *Artificial leather. N. V. Vereenigd Industrieel Bezit No. 7.* (22.5.34; *Germany*, 20.5.33)

In the manufacture of artificial leather having a rubber content of 38–60 per cent. by impregnating a coherent loose body of fibres with a rubber dispersion or solution, the surface of the fibrous mass is treated before impregnation with a very slight proportion of an adhesive, particularly a solution or dispersion of rubber, in such a way that the fibres stick together but the permeability of the surface for the impregnating agent is not substantially reduced. Latex is preferred for the adhesive and for the impregnating material.

No. 440443. *Insulating building slabs. H. Stössel.* (19.7.34; *Germany*, 17.8.33)

Insulating building slabs are made from seaweed in fibrous form, and a binding medium, which is preferably rubber in the form of concentrated latex.

No. 441477. *Wear preventive preparation for application to socks, stockings, and other apparel. A. Skipsey.* (12.7.34)

Socks and stockings, particularly the heels thereof, are protected from wear by being treated with a dilute vulcanized latex, the viscosity of which is increased by the addition of gelatin, casein, bentonite, or calcium phosphate. The mixture, which may be coloured and perfumed, is painted on the garment and dries to form a surface skin; the latex does not penetrate the material and therefore does not impair the softness of the article.

No. 442002. *Saturated fibrous sheet material. A. H. Stevens, for Raybestos Co.* (28.4.34)

Paper which is saturated with a binder, as opposed to being merely surface-treated, is made by confining the wet web of paper between two porous supports, such as metal screen of fine mesh, or open mesh cloth, passing it through the saturant bath, removing the upper porous surface, allowing the web to swell in the presence of an excess of saturant, and then subjecting the web to pressure to reduce its thickness and remove part of the binder. Latex, compounded with accelerators, vulcanizing agents, fillers, or other ingredients may be used as the binder.

No. 442219. *Material for making dressings, bandages, and the like. D. Sarason.* (27.7.34)

Woven material is impregnated with latex in such a way that the dried film adheres to another rubber surface when pressed on, and cannot be removed by a strong pull in the plane of the fabric, though it is easily removable by rolling. The adhesive does not adhere to skin, hair, or surgical instruments.

No. 443156. *Transmission belts. Société des Procédés Ecla, formerly known as Le Filastic.* (21.8.34; *France*, 25.11.33; 2.6.34)

A tubular loose-mesh fabric is made from "inverse twists", the manufacture of which is described in No. 422960. The fabric is then treated with an acid or an alkali which causes transverse swelling and longitudinal contraction of the elements, closing the mesh of the fabric. The fabric is then thoroughly impregnated with rubber by means of rubber solution or of vulcanized, semi-vulcanized, or compounded latex. It is essential that the rubber shall thoroughly penetrate the fabric and shall adhere well to the fibres. The material is then vulcanized, with or without tension, or under the influence of previously applied tension. Rings are then cut from the tubular fabric, each ring comprising one belt; belts of square or trapezoidal section can be obtained according to the method of cutting.

No. 443458. *Porous elastic fabrics. P. H. Head.* (8.1.35)

Porous elastic fabric stretchable in two directions is made by tensioning a stretchable non-rubber fabric base in the direction of its natural stretch to an extent less than the maximum stretch obtainable, surface-treating (as by spraying so that the surface is still left porous) with a vulcanizable latex, and maintaining the fabric under tension until the coating dries. The process also includes adhering to the rubber-sprayed surface of the fabric a coating of fluff, lint, fly, flock, or powdered fibre, to produce a fleecy or downy surface. In the case of underwear, such a surface can be worn next to the skin.

No. 445930. *Felts or unwoven fabrics. A. G. Sladdin.* (21.9.34)

The object of this process is to provide an improved unwoven fabric by impregnation with a latex composition, which renders the fabrics unshrinkable, resilient, waterproof, soft to handle, and pliable. A web of carded loose vegetable or animal fibres, such as cotton, jute, wool, mohair, alpaca, or artificial silk is used. Impregnation is effected by rollers dipping into the latex, surplus liquid being expressed by passing between squeeze rolls.

No. 446300. *Resilient seats. J. A. Howard and Moulded Hair Co., Ltd.* (14.11.34)

The invention relates to seats of the type in which upstanding resilient supporting devices are covered with a mass of upholstery fibres associated in a loosely bound condition with an adhesive such as latex, and provides for the resiliency of the supporting portions being similar to that of the fibrous portion. This is effected by moulding rectangular or other shaped cavities in the fibrous mass and filling these with sponge rubber, either by setting frothed latex in the cavities, or by cutting suitable blocks from a thick sheet of sponge rubber.

No. 446853. *Fibrous material. United Cotton Products Co.* (11.3.35; *U.S.A.*, 28.4.34)

A lap of fibrous material is taken from the doffer of a carding machine by a comb and passed through a walled or enclosed conduit. During its passage through the conduit, the lap is subjected to a current of air, with the result that the fibres become interlocked and interwoven with each other.

No. 447054. *Pressed fibrous artificial sheet material. O. Baur, trading as Bawa Sohlen-Industrie Derendingen-Tubingen.* (6.11.34; *Germany*, 18.11.33)

Artificial leather which is suitable for the manufacture of shoe soles and packing materials is made by grinding a fibrous mass of leather scraps or asbestos until it is reduced to its individual fibres, without, however, the shortening or splitting of the fibres. This mass is thoroughly mixed with latex and the rubber precipitated, as by addition of alum. The mass is placed in a cylindrical press, which may have a centre core, and dehydrated by pressing until no further moisture can be removed. The cylindrical hollow or solid mass is clamped in a machine in which it rotates against a blade, such as a band saw, which peels a layer of any desired thickness from the circumference of the cylinder. The material produced has the advantage over previous materials that it is limited in width only, it being possible to make the sheet of any desired length.

No. 448122. *Articles of spongy rubber material. J. A. Howard.* (30.11.34)

A rubber mixture prepared for the formation of sponge or cellular rubber is distributed over the surfaces of open-textured masses of upholstery fibres, such as horsehair, individually coated and held together by rubber deposited from latex, and a volume, for instance a mould, is filled with the treated fibrous mass. On the formation of the sponge or cellular structure, the several individual masses become embedded in the formed mass of sponge or cellular rubber, and give a composite product shaped to the mould. The sponge rubber may be formed from *crêpe*, sheet, or latex rubber.

No. 448711. *Showerproof fabrics. E. W. Madge, E. A. Murphy, and International Latex Processes, Ltd.* (22.12.34)

Fabrics which while water-repellent are permeable to gases and vapours are made by coating a fabric with an aqueous dispersion of a mixture of rubber and a wax such as a higher homologue of the paraffins, esters, fatty acids, and alcohols, and chlorinated naphthalenes. The total solids content of the dispersion is not more than 20 per cent. and preferably not more than 10 per cent., while the proportion of wax is usually at least 25 per cent. on the dry rubber content of the latex. An example describes the use of carnauba wax in conjunction with latex.

No. 449720. *Surgical dressings, bandages, electrical insulating bindings and other wrappings. F. J. Farrell.* (20.7.35)

The dressings, etc., consist of an extensible textile fabric which has been rubberized by impregnation of the fabric or the yarn with a dispersion of unvulcanized rubber which has had most of the gummy constituents removed and has been heated to render it tacky. In an example, fabric is impregnated with latex so that it is coated with the latex, and the latex is coagulated. The resins are then dissolved by treating the fabric with a

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No. 449941. *Tyre fabric. Wingfoot Corpn.* (3.7.35; *U.S.A.*, 16.11.34)

The weaving of a tyre fabric is combined as a continuous operation with a treatment with an adhesive capable of affording good adhesion between rubber and fabric. A detailed description of the process is given in an example in which the fabric is treated with casein and then with latex, or with a mixture of casein and latex, and is dried, first at a temperature of 120° F., and finally at a temperature of 250° F.

No. 450689. *Manufacture of padding, particularly for upholstery, from cotton wool or like fibrous material. G. W. Chapman.* (23.1.35)

A padding constructed from a continuous fleece is characterised in that a bonding material is sprayed on to the top surface of the uppermost layer of the fleece during the lapping operation for such a width of the fleece as to extend completely or partly through the thickness of the built-up padding. Latex forms a very suitable bonding liquid, and if the degree of spraying is suitably controlled, the latex can form a resilient core for the padding. Flame-proofing materials such as borax or ammonium salts may be added to the latex. A backing of canvas may be applied to the padding, and may be attached to the padding with latex. The latex may contain vulcanizing agents.

No. 451622. *Fabrics coated with waterproof rubber compositions. E. W. Madge, S. D. Taylor, and International Latex Processes, Ltd.* (4.4.35)

An improved process for the manufacture of a fabric with a waterproof coating containing rubber comprises applying to the fabric froths or foams produced from latex. The frothy or foamy nature of the latex is subsequently destroyed, and the layer of latex so produced is set. It is claimed that a froth or foam does not strike through fabrics even though the actual mixing used is fairly dilute. As the effective viscosity of a dilute latex mixing is raised considerably by frothing, a dilute mixing after frothing can be used with ease on a spreading machine, and it behaves similarly to a bank of rubber dough. It does not, for instance, creep under guides. By using froth it is possible to apply very light weights of rubber to and between fabrics. The froth is substantially broken on its passage under the spreading gauge, and is set or coagulated by drying or by contact with a coagulant licked surface.

No. 452176. *Fabrics containing rubber. E. A. Murphy and International Latex Processes, Ltd.* (7.6.35)

The invention relates to the prevention of striking through in the proofing of fabrics with latex. The fabric is fed through one or more nips formed of moving surfaces, such as two rotating rollers, a roller and a belt, two belts, or two moving lengths of fabric, and is treated with latex, which is applied to one of the moving bodies at some distance from the nip and is coagulated before it reaches the nip, where the coagulated film is transferred to the fabric. The nip may be formed by two hard-rubber rollers which are licked with a coagulant, such as a 10-per cent. solution of acetic acid. The weight of coagulated film applied to unit area of the fabric is controlled by the strength of the acid. Frothed dispersions, or latices which have been made capable of gelling on heating, as by addition of sodium or potassium silicofluoride, or ammonium persulphate, or other substances, may be used.

No. 453448. *Hose-piping. N. Lawson and Lewis & Tylor, Ltd.* (13.4.35)

Latex is introduced to the interior of a tube of fabric, for example canvas, and the tube is rotated while the latex dries. The walls of the fabric may have previously been impregnated by introducing latex into the tube under pressure. By varying the maximum pressure on the latex in the fabric tube, or by varying the time, the latex may be caused to impregnate the fabric to any depth desired. The drying may be accelerated by placing the tube in communication with a coagulating medium or a hot-air pump. By rotating the tube at a high speed when sufficient latex has been introduced, the latex can be caused under the action of centrifugal force alone to form a true cylindrical coating on the walls of the tube; and if drying or coagulation is carried out at the high speed, a very smooth and true cylindrical bore is obtained. The hose-pipe may be vulcanized by the application of live steam to the inside of the newly dried rubber lining. Apparatus for carrying out the process is described.

No. 457140. *Artificial horsehair. C. T. Pastor.* (23.5.35; *Germany,* 23.5.34)

Material suitable for upholstery is made by drawing practically endless threads of textile material through a calibrated nozzle fed with a liquid coating preparation which may be latex, rubber solution, or a resin composition. The latex or rubber solution may be compounded. The coating is dried and vulcanized, the threads being formed into a shaped mass before drying and vulcanizing if desired. If a curled hair is required, the thread may be subjected to a swelling agent for the core (not for the rubber), for a sufficient length of time to cause curling, and then set. For example, a rubberized thread of acetyl cellulose is passed through an acetone bath and then through air at 120° C., or through steam when the swollen thread hardens suddenly. The process differs from that of No. 436674 in that the core is not destroyed after the treatment with rubber.

No. 460120. *Upholstery padding. C. Weisleder.* (12.6.36; *Germany,* 13.6.35)

A process for preparing upholstery padding and filling cushion moulds with padding material *in situ* is described. The padding fibres, loosened by combing, are sprayed with latex. After the dry padding fibres have been supplied by an air stream to the mouthpiece at the end of a flexible tube, the latex is applied. The mouthpiece has a spraying nozzle for the latex, as well as compressed air nozzles. The flexible tube is adapted to be presented to the object to be padded.

No. 461582. *Unwoven fabric. A. G. Sladdin.* (15.11.35)

Addition to No. 445930. A web of carded loose textile fibres is passed into a trough containing latex. When the web is thoroughly impregnated, it is passed between rollers to expel any surplus latex and is then partially dried in any suitable way, as described in No. 445930. Predetermined lengths of moist or partially dried fabric are then severed from the roll and placed between appropriately shaped moulds, and, after adjustment by hand to the varying formation of the moulds, pressure and heat are applied to the dies and the fabric caused to assume a shape corresponding to the shape of the dies.

No. 462783. *Permeable imitation leather. T. Shiraishi.* (23.3.36)

Permeable artificial leather is produced by wetting a sheet of carded fibre on a smooth surface with latex containing a finely divided alkaline earth metal carbonate, passing the sheet through acid, which coagulate.

the rubber and simultaneously liberates carbon dioxide from the carbonate to form pores, and vulcanizing the coagulated rubber.

No. 464529. *Featherdown felt. Mercur Müszaki és Vegyipari R.-T.* (9.3.36; *Hungary*, 9.4.35)

The "featherdown felt" described in the specification is a structure of feathers and/or down in which the fibres of the featherdown particles are not matted together but are held together by discrete particles of an adhesive at the crossing points of the fibres. The preferable adhesive is one which is solid at ordinary temperatures, and can be fused by increasing the temperature; finely powdered solid resins are suitable. However, latex may be used as an adhesive, in which case atomised latex is brought into contact with the featherdown particles, the mass is pressed slightly to the right thickness, and the latex is coagulated by means of hot air.

No. 464659. *Fibrous products. F. S. I. Wernersson.* (27.4.36; *France*, 26.4.35)

The resilience of a cushion made of animal and/or vegetable fibres coated with rubber is improved by vulcanizing the mass in a mould in which the mass is compressed so as to cause a reduction of 15–40 per cent. of its uncompressed volume. To overcome the disadvantage of requiring more fibre and rubber for a cushion made in this way, the fibres, before the treatment with rubber, are spun or twisted to form a rope which is impregnated with ammonia, to which keratin may be added. The fibres are then treated with latex or a rubber solution by dipping or spraying, the surplus rubber is removed, and the mass is vulcanized in moulds under compression, as described above. If desired, 5–10 per cent. of sodium silicate or agar agar, or a suitable quantity of albumen, may be added to the latex. Cork, wood dust, or cork wool, treated or not with rubber, may be used with the fibres. The invention renders possible the use for upholstery of previously useless fibres, such as the summer hair of pigs.

No. 466990. *Vulcanized plates of padding material. C. Weisleder.* (12.6.36; *Germany*, 13.6.35)

A process for producing plates of padding material employs fibrous material such as horsehair, curled hair, vegetable fibres, or the like treated with rubber in a liquid form and subsequently vulcanized. According to the invention, a vertically adjustable plate former is used for the material treated with latex. The former is supplied with hot air, and the padding material is treated with rubber and formed to a desired profile in one operation.

No. 468428. *Belts. J. H. Fenner, S. B. Hainsworth, and J. H. Fenner & Co., Ltd.* (3.10.35)

Textile yarns are passed continuously through a number of baths of latex in sequence. The twist is taken out of the yarn temporarily whilst being treated with the latex, the yarn being subjected to mechanical treatment, as by mangling during or subsequent to each immersion. The latex baths may be of increasing concentration and, prior to treatment with the coagulant, the yarn may be drawn through a die. Prior to immersion in latex, the yarn may be treated with a wetting agent and dried until the moisture content is about 15 per cent. Yarns manufactured by this method are woven into textile belts, and the belts coated or impregnated with rubber or latex. The woven belt may be subjected to a vacuum and then treated with latex under pressure. The belt is then dried, preferably under tension, and vulcanized by hot air by heating under pressure.

No. 468529. *Reinforced carded webs. J. H. Goldman.* (10.3.36; *U.S.A.* 15.3.35)

A web of carded fibres is bonded together by impregnation with a binder, such as latex, rubber cement, vinyl resins, or other adhesive. The binder is applied locally into the body of the web, the area of the web occupied by the binder being only a small fraction of the total area of the web. The adhesive is applied by means of rolls, one of which is preferably resilient, being composed of material such as rubber.

No. 468861. *Upholstery padding material. J. A. Howard and Moulded Hair Co., Ltd.* (10.2.36)

Fibres are stiffened with a coating of a material, such as shellac, glue, or rubber, and arranged in an open, loosely associated condition. Latex is introduced into the interstices between the fibres and forms a cellular rubber structure. The individual fibres may be held together by their stiffening coating, or the fibres may be in the form of a continuous web. When the fibres are sheathed with rubber they may be vulcanized before or after the application of the cellular rubber latex mix. Reference is made to No. 448122.

No. 470147. *Pads for garments. A. G. Sladdin.* (2.11.36)

Pads for garments have a number of superposed layers of corrugated material in the form of wadding, felt, or other unwoven material, which are securely held within covering layers of suitable material by adhesive, which may be latex.

No. 471231. *Waterproof fabrics permeable to air. M. A. Chavannes and F. F. Schwartz.* (10.11.36; *France*, 15.11.35)

A process for the manufacture of a textile material, waterproof, but permeable to air, comprises applying to a woven or knitted textile material a water-insoluble plastic or elastic substance in amount insufficient to close the interstices between the threads of the fabric, and afterwards subjecting the coated fabric to mechanical pressure and optionally to heat, so as to reduce the size of the interstices of the fabric to a point at which passage of water through them is prevented, the fabric still remaining permeable to air. The water-insoluble substance may consist of rubber applied in the form of latex, which may contain vulcanizing agents.

No. 472707. *Method of and machine for making cemented pile fabric. A. H. Stevens, for R. S. Allen.* (27.4.36)

The machine comprises means for delivering a fibrous web, mechanism for co-operating with it for automatically moving or feeding severable separator strips in a plane transversely of the web so as to plait the web about them, and means for applying base fabrics to both faces of the plaited material thus formed, and for splitting the structure including the strips. Rubberizing mechanism may be included, such as nozzles for spraying latex on to the surface of the plaited material, which is then frictioned by means of rollers, dried, and vulcanized under pressure. After vulcanization, the material is split longitudinally.

No. 474488. *Artificial leather. Vereenigd Industrieel Bezit "Veritex" N.V., formerly known as N.V. Vereenigd Industrieel Bezit No. 7.* (4.9.36; *Holland*, 23.9.35)

Addition to B.P. 439108. A process is described for manufacturing artificial leather by impregnating a cohering loose body of fibres with a rubber dispersion or solution. The body of fibres is passed between low-pressure cylinders while a non-viscous rubber dispersion or solution is supplied between the cylinders. The product is then dried and calendered. The calendered material is then provided at the back and/or front face with a rubber dispersion or solution containing a large amount of fillers. The dispersion is spread by means of a knife-spreading machine in such a way that the dispersion penetrates into the material. The artificial leather may be finished by coating with a cellulose derivative lacquer.

No. 477393. *Treatment of textile yarns or threads with rubber. J. H. Anderson, J. H. Fenner, S. B. Hainsworth, and J. H. Fenner & Co., Ltd.* (22.5.36)

A method of impregnating textile yarns or threads with latex is to pass the thread through a flexible diaphragm sealing the submerged entrance to a vessel containing stabilised latex, and through the latex surface to the atmosphere, where it is dried prior to its making contact with any guide of deflecting surface. The flexible diaphragm may be of rubber and permits knots in the thread to pass. Previous to passing into the latex, the thread may be soaked with a coagulating liquid.

No. 479141. *Reinforced paper. W. H. Millspaugh.* (18.8.36; *U.S.A.*, 25.4.36)

A web of paper, formed by vacuum formation on a suction forming roll, is reinforced by means of fabric. Before applying the fabric to the paper, the fabric may be coated with an adhesive such as latex by passing the fabric through the nip of coating rolls. After the application of the coated or uncoated reinforcing fabric to the paper, the reinforced paper web is subjected to heat and pressure. Previous to drying, an outer web of paper may be applied to the reinforced paper web.

No. 479960. *Mattresses. J. A. Howard and Hairlok Co., Ltd.* (2.10.36)

In a mattress or like article composed of a fabric envelope distended by an upholstery pad of rubberized fibre with interposed loose padding material, the fabric envelope consists of two layers of fabric with the padding material enclosed between them. The fabric has a readily openable and closable portion to permit ready removal and re-insertion of the rubberized fibre pad when it is required to remove the pad prior to cleaning the mattress. The upholstery pad is formed of curled horsehair, the hairs of which are united at their crossing points by rubber deposited from latex and vulcanized. Reference is made to Nos. 341936 and 355004.

No. 480834. *Coating fabrics. Vereenigd Industrieel Bezit Veritex N.V.* (13.4.37; *Holland*, 17.4.36)

Flexible materials such as textile fabrics, leather, or artificial leather are provided with a lacquer coating by successively applying to the material one or more priming layers composed of a rubber dispersion containing a large proportion of fillers, two or more intermediate layers containing both rubber and a film-forming substance miscible with rubber and adapted to adhere to cellulose lacquer, and finally a coating of cellulose lacquer. The composition of the successive intermediate layers is progressively different, so as to obtain a gradual transition from the priming layer to the coating of lacquer.

No. 481079. *Articles comprising rubber bonded to fabric comprising cords of or containing artificial silk. R. F. McKay, for International Latex Processes, Ltd.* (23.7.37)

In making rubberized tyre fabric in which the fabric is composed of artificial silk cords, the rubber is bonded to the fabric by the solids deposit of an aqueous dispersion of rubber containing proteinous material and carbon black. Preferably the aqueous dispersion contains reclaim and preferably the reclaim is whole tyre reclaim containing the necessary carbon black. The use of the above bonding material increases the adhesion between the artificial silk cords and the rubber as shown by cold and hot stripping tests and by flexing tests. Reference is made to No. 178811.

No. 481587. *Printers' blankets. Dewey & Almy, Ltd., for Dewey & Almy Chemical Co.* (11.3.36; 26.10.36)

Printers' blanket consists of a number of piles of napped woven textile material impregnated with a rubber dispersion and bonded together in such a way that a rubber cushioning layer is formed between adjacent plies. Such a blanket is suitable for printing large designs where maximum resilience is necessary.

No. 481610. *Waterproofing textile materials. G. H. Ellis and E. Stanley.* (19.9.36)

A method for waterproofing knitted fabrics containing yarns of an organic derivative of cellulose is described. The fabric is treated with a dispersion containing rubber, wax, and a soap of a volatile base. The soap is subsequently decomposed by heat treatment.

No. 482679. *Elastic fabrics. M. A. Chavannes and F. F. Schwartz.* (15.12.36; *France*, 21.9.36)

In a process for the manufacture of an elastic and air-permeable fabric consisting of a knitted or woven fabric associated with rubber or like material, the surface of the fabric is modified by embossing or other deforming operation so as to form projecting portions. Latex in the form of a finely divided spray is applied to the projecting portions, the remaining portions of the fabric being uncoated. Reference is made to No. 482767.

No. 482683. *Elastic fabrics. M. A. Chavannes and F. F. Schwartz.* (28.1.37; *France*, 5.12.36)

Elastic fabrics are manufactured by spraying with latex one surface of a piece of extensible fabric without rendering the fabric non-porous, and while the rubber is in a condition in which it is capable of being compacted by pressure, applying mechanical pressure to the surface of the fabric along continuous lines in order to increase the resistance of the fabric to stretch by compacting the rubber along these lines, and at the same time to retain the porosity of the unpressed portions of the fabric. Reference is made to No. 482679.

No. 482767. *Elastic fabrics. M. A. Chavannes and F. F. Schwartz.* (16.12.36; *France*, 21.3.36)

A porous elastic fabric consists of an extensible fabric base having on one or both sides a foraminous covering of elastic material such as rubber adhering to the fabric base, substantially only at the salient or projecting parts of the surface without directly connecting the threads of the fabric at their intersections. The rubber is applied by spraying a vulcanizable latex composition while the fabric is unstrained. Several coatings are applied, each being coagulated and dried before the next is laid down. The nature of the spray is regulated by the spraying conditions. The latex may contain a reagent which coagulates it when a portion of the preservative ammonia has evaporated, *e.g.* ammonium borate or acetate or an ammoniacal complex of zinc borate or acetate or another salt of zinc having a weak acid radical. Fabric may be coated on one or both sides, or two fabrics may be attached together with the rubber between them.

No. 482844. *Elastic fabrics. M. A. Chavannes and F. F. Schwartz.* (18.12.36; *France*, 30.9.36)

The specification relates to apparatus for the preparation of elastic fabric by the method described in No. 482767. The fabric to be treated is stuck by adhesive (which is subsequently washed off) in an unstrained condition to the flat surface of an endless belt, and passed through the spraying chamber. More than one passage may be made, 30 seconds sufficing for one treatment. If desired, the rubber may be rendered tacky by a solvent, and two fabrics stuck together.

No. 483381. *Wool-packs. J. Carlin.* (15.10.36)

Latex-treated jute or other fabric prepared according to the method described in Nc. 483393 is used for the manufacture of wool-packs. The treated fabric is cut into strips of such a width that two strips, placed one on the other at right angles, can be bent to form the wool-pack, the base of the pack having two layers of fabric. The latex on the lower strip over the area where the two strips are in contact is not coated with sulphur and talc but is left in an adhesive condition so that the two strips will be bonded together by the latex. To prevent fibres from breaking away from the top edges of the wool-pack, the edges are folded inwardly and pressed into the latex layer. The other edges of the strips are fastened together with twine, preferably treated as described in No. 483393, to form the wool-pack.

No. 483393. *Wool-packs. J. Carlin.* (12.11.36; *Union of South Africa,* 18.3.36; 2.11.36)

It has already been proposed to coat jute fabric for wool-packs with latex in order to prevent fibres from the jute fabric from contaminating the wool. This process is now modified in that the latex, after application to the jute fabric, is dried to such an extent that a film of rubber forms but the film does not harden, and powdered sulphur or zinc oxide is applied to the film. Talc is preferably subsequently applied. This treatment removes the tackiness of the rubber but does not effect appreciable hardening or vulcanization of the rubber. The latex-treated fabric is pressed after drying of the latex and after application of the dusting agents. It is usually necessary to treat only the side of the fabric which becomes the inside of the container, and the treated fabric has the further advantage that it is resistant to rot and to the effects of moisture. Thread used for closing and repairing wool-packs may be treated similarly.

No. 483496. *Treatment of textile materials with rubber. C. M. Blow, B. H. Wilsdon, Rubber Producers Research Assn., and Wool Industries Research Assn.* (22.10.36)

In the deposition of rubber from aqueous dispersions on to textile fibres, the fibres are pretreated with an aqueous solution of cationic soap compounds, *e.g.* cetyl pyridinium bromide, cetyl trimethyl ammonium chloride, or cetyl dimethyl sulphonium methyl sulphate, which in solution give a positive ion comprising a long chain aliphatic residue. The pretreated fibres are subsequently immersed in an aqueous dispersion of rubber so that deposition of rubber on to the fibres occurs. The process is analogous in some respects to dyeing. The air permeability of the textile material is impaired only to a minor extent, but additional qualities of strength, resistance to wear, and water-repellancy are obtained. The treatment with rubber, by this process, of textile materials to be used, for example, in the reinforcement of tyres, gives improved adhesion between the textile and rubber in the finished article.

No. 484792. *Pile fabrics. A. J. Stephens, for Collins & Aikman Corpn.* (5.10.36)

Divided out of No. 484795. A V-pile fabric suitable for upholstery has the pile V's looped in weaving about single wefts of a backing fabric which is composed of backing warps and wefts to form a single-plane ground for the pile loops. A latex binder is incorporated, substantially locally, in the backing threads and that portion of the tufts which lie in the same plane. A less quantity of binding material is required in a fabric of this type than in prior fabrics. Preferably the fabric used is woven in accordance with the method described in No. 484795.

No. 484795. *Pile fabrics. A. J. Stephens, for Collins & Aikman Corpn.* (5.10.36)

A method of weaving a pile fabric is described. After weaving, the fabric is preferably scoured to remove water-repellent substances prior to the application of a latex binding material as described in No. 484792.

No. 485705. *Shoulder pads for garments. F. Chassaing.* (19.4.37; *France*, 27.4.36)

A shoulder pad for garments consists of a core of entangled fibres agglutinated by a dispersion or solution of rubber, the core being covered with textile material. The pad is made by moulding the core, then applying to both sides of the core adhesive coated fabric, and then moulding the whole preferably with simultaneous application of heat. The pad is finally trimmed.

No. 486197. *Coated and composite web materials. W. J. H. Hinrichs.* (27.8.36)

Addition to No. 435394. A machine for the production of composite webs comprising paper, textile, or like material, consists of at least two sections, each having means for feeding the web, coating arrangements, and a drying conduit. By means of a press-roll system the webs from each section are pressed together with their coated surfaces in contact. The invention may be used with coating compositions made in accordance with No. 435394, or with other compositions comprising rubber or the like in solution or suspension. It is suggested that with porous paper, a latex with as low a concentration as 10 per cent. may be used, but with well-sized papers the concentration may be 25–30 per cent. of rubber.

No. 486647. *Hosiery. G. H. Piper.* (1.11.37)

Socks and stockings are reinforced against wear in the toe and heel portions by brushing the finished articles with 40 per cent. rubber latex. Conditions are chosen so that the latex does not penetrate the meshes of the sock, and air may be blown through to free the meshes from rubber. The rubber is dried off by a current of warm air and is vulcanized either by cold vulcanization or by hot vulcanization, in which latter case the latex must have been suitably compounded. Alternatively vulcanized latex may be used.

No. 488080. *Applying flock. W. F. Feinbloom.* (8.11.37)

Flock is applied to the finish face of a knitted or woven fabric by applying to one face of the fabric a liquid adhesive (casein, glue, rubber cement, latex, or other suitable material) of such thin consistency that it penetrates partly through the fabric. Flock is dispersed on the fabric, which is then stretched to allow the adhesive to form deposits in the interstices and to become impregnated in the fibres. The fabric is then subjected to slow beating, to work the flock into the adhesive deposits and to cement it to the fibres at such a depth that it is held between adjacent fibres. The stretching is then relieved.

No. 489031. *Spongy masses and articles of rubber. J. A. Talalay.* (8.12.36, 15.3.37)

The specification describes an improvement on the process of No. 455138. According to the earlier specification, an upholstery material is made by reducing the pressure over a rubber dispersion and so allowing the dispersion to expand and to permeate a fibrous mass. This process has the disadvantage that the expanding foam disarranges the fibrous mass, which tends to matt together. According to the present invention, this matting together is prevented by bonding together the fibres of the mass before it is permeated by the frothed latex. This bonding may be effected by treating the mass with a suitable adhesive, such as rubber, casein, gelatine, or rosin, which is applied by spraying or dipping. When a soluble adhesive is used it may be removed later by treatment with a suitable solvent. Alternatively, there may be used a fibrous structure containing interlocked or interwoven fibres, when bonding by an adhesive is unnecessary. The suitably treated fibrous mass and latex, which must contain substances capable of irreversibly evolving gas under the frothing conditions, as well as stabilisers, are placed in a suitable vessel, which may act as a mould. If the fibre does not fill the whole of the vessel, it is preferably anchored in place by wires, nails, or similar devices extending inwards from the sides of the vessel; if the finished structure is to contain cavities, the blocks used to form these cavities may also act as anchoring means. The pressure in the vessel is then reduced, allowing the foam to expand and permeate the fibrous mass. The structure can finally be vulcanized.

No. 491840. *Resilient material for stuffing upholstery, mattresses, and the like. J. A. Talalay.* (8.12.36; 15.3.37)

Divided out of No. 489031. A bulky, reticulated, fibrous mass, reinforced with rubber or rubber-like material, is produced by causing a fluid-bearing rubber or rubber-like material to extend itself as a foam through the interstices of a bulky, fibrous mass, collapsing the foam while it is permeating the fibrous mass, and then causing the collapsed foam to set. The starting fibrous mass may have its fibres bonded together before applying the process of the invention. Any elastic or non-elastic adhesive may be used for this purpose, for example, dispersions of rubber or rubber-like material, either vulcanized or unvulcanized, or casein. For the material to be made into a foam, use may be made of a dispersion or solution of unvulcanized or vulcanized rubber or rubber-like material. It may contain the usual additions, such as vulcanizing agents, accelerators, setting agents, pigments, fillers, and thickeners.

No. 494231. *Impregnated products. J. Lecacheux.* (20.4.37)

A method and apparatus for preparing a thick artificial leather by impregnating fabric with latex are described. The fabric is unrolled on to a table, preferably heated, the latex composition is applied, and pressure is exerted to ensure thorough impregnation. If desired, several thicknesses of fabric so treated may be pressed together. The latex composition includes water, a wetting agent, a stabiliser, a vulcanization accelerator, and sulphur.

No. 495264. *Finishing hair cloth. J. H. Gaskell.* (14.5.37)

Fabric such as mungo fabric can be finished to give a hair cloth effect by a two-stage finishing process. The first consists in passing the fabric through a bath of latex containing barytes, fuller's-earth, or other fulling material such as china clay or lead oxide followed by a wiping action to leave a smooth surface. The fabric is then heated and passed through another bath containing a mixture of acetic and sulphuric acids, starch, soap, and in some cases wax. The fabric is then squeezed and calendered as usual.

No. 495539. *Elastic fabric. M. A. Chavannes and F. F. Schwartz.* (17.3.38; *France*, 18.3.37)

In the manufacture of elastic fabric, the fabric is first submitted, in the unstretched condition, to the action of a liquid containing a wetting agent and one or more chemical agents which cause the threads to contract and diminish the size of the pores, and is then sprayed with latex in such a way that the elements of the fabric are not stuck together. Such a fabric will have a much greater extensibility in all directions than a fabric which has not been submitted to the contraction process. The spraying may be carried out as described in Nos. 482767 and 482844, and the fabric may be embossed, prior to spraying, as described in No. 482679.

No. 496902. *Waterproofing of fabrics. M. A. Chavannes and F. F. Schwartz.* (24.9.37; *France*, 14.5.37, 23.6.37, 1.7.37)

In the manufacture of a waterproof fabric, a closely woven or knitted fabric, which is substantially inextensible, is first sprayed with latex so that discrete globules are formed on it. The globules are coagulated and dried to form projecting surfaces upon which a subsequent deposit or deposits of latex are formed by spraying. The resistance of the fabric to water may be increased by treatment of the fabric with a water-repellent substance after application of latex to it and after coagulation of the rubber.

No. 497793. *Treatment of textile materials with latex. C. M. Blow, B. H. Wilsdon, R.P.R. Assn., and Wool Industries Research Assn.* (27.5.37)

Latex is treated with a cationic soap solution to impart to the rubber particles a reversed, that is a positive charge, and an affinity for surfaces carrying a negative charge such as textile fibres, glass, asbestos, and the like. Typical cationic soaps are cetyl pyridinium bromide, cetyl trimethyl ammonium chloride, and cetyl dimethyl sulphonium methyl sulphate. Such a treated latex, when applied to textile or like material, gives an even deposit of rubber in a short time prior to removal of the water from the latex. The deposit adheres well to the textile material, and the handle, air permeability, and other qualities of the fabric are impaired only to a very minor extent by the treatment, whereas the strength, resistance to wear, and water repellency are increased.

No. 498047. *Process and apparatus for wet-felting fibres. J. Kläsi.* (9.7.37)

In a continuous process for wet-felting fibres, particularly textile fibres, the dry fleece is moved past a system of nozzles by means of a conveyor belt, the nozzles conducting water to the dry fleece in a number of flat, film-like jets, in such a manner that the fleece is permeated by the liquid. It is mentioned that for producing leather-like products the fleece is soaked with a latex composition, although no claim is made for the impregnation of the fleece with latex.

No. 498591. *Surgical bandages. L. T. Sawyer.* (8.5.37)

The bandage consists of an open-mesh textile fabric base, with relatively large interstices, coated with an underlying coat of vulcanized latex which leaves the interstices open, and with a superposed coating of substantially unvulcanized latex above the undercoat. The sub-coat may be formed from vulcanized latex sheets applied by pressure with rollers, or from emulsion by spraying or dipping. In the former method very thin sheets are used, which give way at the interstitial openings and tend to wrap round the threads. The unvulcanized coat also may be applied in sheet or emulsion form. The effect is a bandage which readily adheres to itself of both sides but not to skin or hair.

No. 498649. *Elastic fabrics. M. A. Chavannes and F. F. Schwartz.* (25.3.38; *France*, 25.3.37)

In Nos. 482679, 482767, and 482844, processes are described for forming elastic fabric by spraying latex on to the fabric so that it settles only on salient or projecting parts of the fabric, for giving the fabric suitable salient formations, and for sticking together two such fabrics by means of the rubber layers. In the present invention, a compound fabric is made by coating only one layer densely, as in the foregoing inventions, the second layer being sprayed with latex only sufficiently to cause it to adhere permanently to the first layer when they are placed together. Special fabrics, formed with particular salient parts, lend themselves to particular applications of this invention, with or without reinforcing members, spaces or pockets, and so on, in the formation of the compound materials.

No. 505794. *Leather substitutes. H., O., R., and W. Freudenberg, personally responsible partners of the firm C. Freudenberg, and C. L. Nottebohm.* (26.2.38)

Leather substitutes are made from unwoven sheet material by treating carded fibre fleeces on one side with agglutinating water-insol uble sub stances, passing two fleeces thus pretreated and dried together between a pair of rollers in such a manner that the pretreated sides of the fleeces are on the outside, and introducing the binding agent between the fleeces. The agglutinating agent is used in such quantities that, after drying, a closed surface will be produced which will be partly impervious to the binding agent employed in impregnation. Latex may be used as the agglutinating agent and as the binding agent.

No. 507493. *Treatment of cotton or the like to improve the adhesion of rubber thereto. E. W. Madge, E. A. Murphy, and Dunlop Rubber Co., Ltd.* (15.12.37)

The cotton is dewaxed, for example, by immersion in hot 5 per cent. caustic potash, and is then treated with a latex adhesive containing resorcinol resin, obtained, for example, by the condensation of resorcinol and formaldehyde. The process is suitable for treatment of cotton duck for power transmission belting and cotton cord for tyres.

No. 508136. *Treating fibrous material. International Latex Processes, Ltd.* (9.6.38; *U.S.A.*, 19.6.37)

The differences between immersion and entrainment processes for depositing rubber from latex on fibrous material are explained. The object of the invention is to treat fibrous material with latex by an entrainment procedure that maintains in the treated product the untreated fabric feel hitherto associated only with the products of some latex immersion processes. Fibrous material, substantially free from coagulant, is treated with a latex composition by maintaining the fibrous material in contact with a relatively small amount of the latex composition. The latter is adjusted with a coagulant and a protective agent so that, while on either side of the isoelectric zone according to the nature of the fibre, the latex composition is stable at the temperature of treatment when not in contact with the fibrous material, but unstable in the presence of the particular fibrous material treated.

No. 508137. *Treating fibrous material. International Latex Processes, Ltd.* (9.6.38; *U.S.A.*, 19.6.37)

The object of the invention is to treat fibrous material with latex and to deposit the dispersed rubber on to the fibrous material in such a manner that the product maintains the "fabric feel" and retains the appearance of untreated fibrous material. Fibrous material, substantially free from coagulant, is maintained in contact with a latex composition which has a *p*H approximately in its isoelectric zone and contains at least sufficient, and not much more than sufficient, of protective agent to make the latex composition stable at the temperature of treatment when not in contact with the fibrous material, but unstable in contact with the fibrous material.

No. 511613. *Treatment of jute or the like. J. Carlin.* (29.3.38)

The invention relates to a latex treatment of jute and like fibres having a hairy or fluffy character. Wool packed in ordinary jute bags becomes contaminated with jute fibres. This is prevented by the process of the invention. The treatment may also be used for imparting non-slip properties to carpets and belting, and resistance to damp, climatic conditions, or rot. The treatment comprises applying latex to the yarn, partially drying the latex, and afterwards treating the latex with a cold vulcanizing agent, such as sulphur chloride, or with a coagulating agent, such as acetic or formic acid.

No. 512558. *Preparation of textile yarns. J. Brandwood.* (18.12.37)

A textile yarn is produced from a textile slubbing or roving without the usual spinning operation by impregnating the fibres of the slubbing or roving with a weak solution or dispersion of rubber, latex, or a synthetic resin, preferably latex of 2–10 per cent. concentration. Liquid or dispersion remaining in the interstices between the fibres as a result of the treatment is then cleared from such interstices by means of a compressed gas at high velocity. The fibres, after drying, adhere directly together without relative slip. Before ultimate drying, the yarn may have imparted to it a few turns per inch of twist, for example, two turns per inch, in the same direction as that of the carrier twist. A very compact yarn, suitable for sewing, is thus formed.

No. 514772. *Preparation of doubled textile yarns or cords. J. Brandwood.* (17.3.38)

The process described in No. 512558 is modified in that while the latex-treated yarn or thread is still wet, it is folded or doubled with some degree of twist and is subsequently passed, while still wet, through a weak latex followed by drying under tension. The cord formed is specially suitable for tyres and transmission belting. .

No. 516365. *Fabrics coated with rubber or like natural or artificial resin. S. D. Sutton, and Veedip, Ltd.* (22.6.38)

The invention relates to the production on one surface of a fabric of a coating of rubber which does not penetrate the fabric. The surface is first subjected to a fine spray of latex which does not strike the fabric forcibly but drops on it as a fine rain, to deposit thereon particles of rubber separated by comparatively small interstices. One or more layers of latex are then applied by dipping or spreading, to build up a coating of any desired thickness.

No. 519665. *Textile yarns or threads. J. Brandwood.* (11.10.39)

As a further step in the production of a textile yarn from a roving or slubbing as described in No. 512558, and which yarn in the moist and cleared condition as a roving or slubbing has had imparted to it a few turns of twist per inch of length in that condition, continuous longitudinal tension is applied to the yarn in that condition and while it is being dried. Component fibres after such drying adhere directly together without relative slip. Any undesired partial drying of the roving or slubbing may be compensated for by passing the same through a bath of a weak dispersion, for example, of latex, and thence through the tensioning and drying means.

No. 521034. *Fibrous upholstery stuffing. E. O. Whiteley.* (21.1.39)

Upholstery stuffing material is made by coating loose fibrous material with a film of resilient rubber in such a way that the coated fibres are unattached at points of crossing. The rubber surface of the fibres is treated so that it becomes wrinkled and reduces slipping of the fibres with respect to each other. Such treated fibres have a bulk of up to 20 per cent. more than untreated fibres. Latex is the preferred coating material, the fibrous material being exposed to steam vapour charged with acetic acid and then immersed in latex. Vulcanized latex or chlorinated rubber latex may be used.

No. 521108. *Treatment of regenerated cellulosic materials to render them unitable to rubber. H. Dreyfus.* (8.11.38)

A composition consisting of latex and an unstable compound of cellulose, for example, alkaline cellulose xanthogenate, is applied to the regenerated cellulose. The latex is then coagulated and the cellulose compound decomposed by treating the composition with acid or by the application of heat. The material is then washed and dried and applied to a rubber composition and the whole vulcanized. The method is especially applicable to the manufacture of tyres having cords of regenerated cellulose.

No. 521196. *Textile yarns. J. Brandwood.* (24.10.38)

Textile yarn of a soft and lustrous character and of sufficient tensile strength to withstand winding and weaving tension is formed from discontinuous fibres without spinning, by treating a textile roving or slubbing with a solution or dispersion of a substance having cohesive qualities, the solution being of a strength sufficient to impart increased frictional resistance, without fixed cohesion, to separation of the fibres when the latter are dried. The excess of solution is removed from the fibres, which are subsequently dried. Latex is a suitable material for use as the cohesive substance, and preferably the treatment is carried out by the method described in No. 482817.

No. 522068. *Preventing mats from slipping. F. R. Stone and F. Stone (Kidderminster) Ltd.* (5.1.39)

A non-slip material for use with mats consists of an open-mesh fabric treated with latex or rubber so as to provide webs or films of rubber extending across some or all of the openings of the mesh forming shallow depressions or cells at each side of the material.

No. 522220. *Artificial leather-like products. H., O., R., and W. Freudenberg (Partners of Kommanditges. C. Freudenberg).* (8.12.38; *Germany*, 23.12.37; 30.7.38)

Artificial leather made by impregnating fibre fleeces with natural or synthetic rubber is treated, without tension, with bases such as caustic soda or potash solution, ammonia, or sodium carbonate until the fibres swell, the base subsequently being removed by washing with or without the help of neutralising agents. The treatment gives the surface a pattern corresponding to the native grain of natural leather and also imparts a leather-like elastic feel. A latex-leather is mentioned in a detailed example.

No. 525440. *Method of providing fibrous materials with a finishing coating or varnish. Società Anonima Prodotti Salpa & Affini S.A.P.S.A., assignors to International Latex Processes, Ltd.* (21.2.39; *Italy*, 25.2.38)

Fabrics, hides, leather, artificial leather, and natural and synthetic rubber are varnished in two stages. A backing layer of a latex composition is first applied, a typical mixing being: latex (60 per cent.) 24, ammoniated casein solution (15 per cent.) 15, pigment 24, water 15, ammoniated casein solution (15 per cent.) 3—the last three components being dispersed together and added to the first two. After this backing is dry, a varnish finish is applied such as latex (60 per cent.) 0·8, ammoniated casein solution (15 per cent.) 2, formaldehyde solution (40 per cent.) 0·3, polyvinyl acetate resin emulsion (30 per cent.) 1·75. A further top coating may be added such as polyvinyl acetate resin 2, benzol 8, pigment 0·4, and if desired, still further coats may be applied of cellulose lacquer or synthetic resin.

No. 526274. *Belts made of textile and rubber. A. Touchon.* (11.3.39)

In the production of belts made of superposed layers of fabric impregnated with latex, the fabric is wound under tension round an extensible mandrel rotating about its axis. Belts are produced having no join or gap, and which are practically inextensible. Vulcanization may be effected under pressure, two opposite parts of the belt being separated by a metal plate of good heat conductivity and clamped between the two plates of a press, these plates likewise being of a metal of good heat conductivity and heated by the circulation of a fluid such as steam.

No. 528435. *Method of coating fabrics. International Latex Processes, Ltd.* (8.5.39; *U.S.A.*, 12.5.38)

To avoid latex striking through a fabric and to avoid serum and non-rubber constituents of latex liberated at the fabric surface by syneresis travelling through the fabric, both latex composition and fabric are pretreated so that the latex rapidly gels when deposited on the fabric. This is done by applying to the fabric a boron compound such as borax, sodium perborate, or boric acid, and at the same time incorporating in the latex a gum which is gelled by the boron compound. Such gums are locust-kernel, locust-bean, carob-seed, carob-bean, and other gums derived from the fruit of the algaroba, locust, or carob tree. A heat-sensitised latex may be used, coagulated in the gel by heating the fabric. The fabric after impregnation with, say, borax solution may be dried, or may at once pass in the wet state to a latex spreader. In an example, 2·5 parts of carob seed gum per 100 parts (dry) rubber were added to the latex.

No. 535154. *Leather substitute. S.A.P.S.A. Società Anonima Prodotti Salpa & Affini, assignors to International Latex Processes, Ltd.* (2.2.40; *Italy*, 4.2.39)

A leather substitute is produced by impregnating an absorbent paper sheet with latex admixed with an aqueous solution or dispersion of a synthetic resin, for example, polyvinyl or polyacrylic resins, and uniting the impregnated sheet to a textile fabric by an adhesive, for example, a vulcanized latex adhesive.

No. 535402. *Artificial leather. A. Friedmann.* (28.10.39)

Artificial leather is made by treating loose fibrous material, for example cotton wool, with a mixture containing milk, gelatin, latex, and starch, and then treating the dried impregnated material with a tanning material and consolidating the product by pressure. A suitable impregnating composition consists of the following: milk 1 litre, gelatin 30 g., potato starch 30 g., latex 0·5 litre, and water 1 litre, while a suitable tanning bath consists of acetic acid 30 g., tartaric acid 10 g., borax 10 g., and water 1 litre.

No. 540469. *Manufacture of duplex fabrics. G. H. Lunge and Clutsom & Kemp, Ltd.* (5.7.40)

Two lengths of textile fabrics are superimposed and bonded together between the rolls of a calender, the bond being produced by spraying from one or more devices, an adhesive consisting principally of latex, in a finely atomised state on to at least one of the fabrics at or close to the line of the nip. The quantity of latex employed is such that no penetration of the fabric occurs. Good results are obtained using a 60 per cent. vulcanized latex. A machine suitable for carrying out the process is described in No. 540475.

No. 540475. *Machine for the manufacture of duplex fabrics. G. H. Lunge and Clutsom & Kemp, Ltd.* (5.7.40)

Divided out of No. 540469. A machine for doubling lengths of sheet or ribbon comprises two calender rolls, means for feeding the sheets to the rolls so that the sheets are in close contact with the rolls for at least half their circumference before entering the nip, and means for receiving the bonded product. There are one or more spray-producing devices which can be moved continuously in front of the calender rolls so as to coat at least one of the sheets uniformly over its whole area with adhesive. At least one of the sheets is coated immediately prior to or during its entrance into the nip of the calender. Vulcanized or unvulcanized latex may be used as the adhesive.

No. 540761. *Hose pipes. D. E. F. Canney and G. Angus & Co., Ltd.* (26.1.40)

Tubular fabric, for example, fire hose, is woven on a circular loom. There is applied to the weft yarn, prior to its introduction into the fabric, a film of sealing agent in liquid form, for example, vulcanized or unvulcanized latex. The weft yarn is woven into the fabric in a wet condition.

The sealing agent partially or completely fills interstices in the fabric. A loom for carrying out the process is described.

No. 543490. *Manufacture of textile yarns or cords. Firestone Tyre & Rubber Co., Ltd., M. M. Heywood and T. R. Hartley.* (23.5.40)

In the manufacture of doubled textile yarns or cords for tyres, belting, etc., yarns having a twist greater than the roving twist are doubled together and the fibres impregnated with latex during the doubling operation without interruption of the continuity of manufacture of the doubled yarn.

No. 543779. *Leather-like materials. K. Dressel and Swears & Wells, Ltd.* (10.9.40)

In the usual processes of making artificial leather by impregnating cotton wool and similar materials with latex or other rubber dispersions, an improvement consists in submitting the textile to a preliminary impregnation with a binding agent such as glue or gum. In practice, layers of cotton wool held between layers of butter muslin or the like are treated with the gum solution and pressed into compact sheets or strips, any surplus gum being removed. The sheets or strips, while still wet, are supported on wire netting and treated with latex in the usual way. An important factor is the removal of all air while compacting the gum-wet cotton wool. Reference is made to No. 543781 for apparatus.

No. 543781. *Leather-like materials. K. Dressel and Swears & Wells, Ltd.* (10.9.40)

In carrying out the process of No. 543779, it has been found important to prevent substantial movement of parts of the cotton wool in its own plane during impregnation. Consequently it is preferred to clamp the cotton-wool sheets between sheets of gauze or wire netting, the clamped bundles then being impregnated by rotation about an axis parallel to but spaced away from the plane of the sheet in a tank of impregnant. A simple system of gauze sheets, wire netting sheets, and thumb-screw clamps is described for forming the bundles of gum-bound cotton-wool sheets.

No. 543785. *Leather-like materials. K. Dressel and Swears & Wells, Ltd.* (11.9.40)

Further to the claims of Nos. 543779 and 543781, there is now claimed apparatus consisting of a rotatable tank for the impregnating agent and a rigid framework or rack within the tank, adapted to support a series of cotton-wool sheets in spaced parallel planes which are parallel to the axis about which the tank rotates. The rack may be a crate-like carrier which can be lifted bodily in and out of the tank.

No. 543786. *Leather-like materials. K. Dressel and Swears & Wells, Ltd.* (11.9.40)

The process comprises the steps of cotton-wool impregnation with glue or gum, compacting the impregnated wool into a sheet or strip, placing of the compacted sheets between constraining sheets of wire netting, impregnation of the constrained compacted wool with latex in a rotating tank, rolling and pressing of the rubberized sheet, drying, and "fixing" in any manner. Reference is made to Nos. 543779 and 543781.

No. 545582. *Elastic fabric for bandages. C. M. Blow, G. C. Burgess, and British Rubber Producers' Research Assn.* (6.1.41)

Elastic fabric for bandages, plasters, and the like is rendered water-repellent and of low water absorption by treating the soft twisted weft or warp yarn and/or the finished fabric with a positively charged latex prepared as described in No. 497793 and with a substance which imparts water-repellency to the fabric. The latex is preferably vulcanized before application. A suitable water-repellent substance is paraffin wax, although a more permanent finish is obtained by use of the substance known under the trade mark Velan P.F.

No. 546171. *Textile materials suitable for use in manufacturing laminated articles. Firestone Tyre & Rubber Co., Ltd.* (9.11.40; *U.S.A.*, 10.11.39)

The invention is applicable more especially to the manufacture of tyres and belting. The method involves impregnation of the textile with a latex composition containing a protein. Afterwards, but prior to vulcanization of a separate rubber composition in intimate contact with the material, the impregnated material is heat-treated to a substantial degree and at temperatures beyond (substantially above 100° C.) that required for merely drying the material, to produce substantially maximum adhesion between rubber and the material in the vulcanized article.

No. 546517. *Outsoles for footwear and methods and apparatus for making the same. Rope-Soles, Inc.* (29.4.41; *U.S.A.*, 15.6.40)

The sole consists of a rope-like band of jute or other suitable fibrous material disposed in side-by-side relation and united together by films, layers, or coatings of latex, thus eliminating need for stitching the rope into shape. Details are given of a machine which carries out the complete sole-making operation, applying latex adhesive along the sides of the rope, coiling the rope to shape within an appropriate mould or frame, and retaining the shaped article in a dense form until the adhesive film has dried.

No. 547820. *Fire hose. M. Balkin, D. E. F. Canney, and G. Angus & Co., Ltd.* (10.2.41)

In a treatment to render a textile hose non-porous, or nearly so, relative movement is effected between the hose and a single pressure member disposed within the hose, or a pair of co-operating pressure members which nip the hose between them. The pressure members serve to exert mechanical pressure on latex supplied between the single pressure member and the hose, or between the two pressure members. Thereby, the latex is squeezed into the interstices of the hose. Subsequently the latex is dried. Reference is made to Nos. 9746/97, 547821, and 553669.

No. 547821. *Fire hose. M. Balkin, D. E. F. Canney, and G. Angus & Co., Ltd.* (10.2.41)

A continuous lining, of substantially uniform thickness, of latex or equivalent sealing agent in liquid or plastic form is applied to a textile hose. The process used consists in introducing a quantity of sealing agent into the hose and traversing a spreader through the hose, and is characterised in that each successive section of the hose through which the spreader passes is maintained open, during the passage of the spreader, and by an agency other than the spreader itself, to a contour conforming with, but slightly larger than, that of the spreader. Reference is made to Nos. 9746/97 and 381307.

No. 550073. *Rubber-coated textile fabrics. L. Landau and Latex Industries, Ltd.* (18.6.41)

Rubber-coated fabrics are produced in which the rubber does not penetrate through the fabric from the coated side to the other. Rubber dispersion or solution is applied, so as to form a film of predetermined thickness, upon an auxiliary non-porous surface of a material chemically inert to the rubber and the medium in which it is dispersed. While the film is in the fluid state the textile fabric is applied to it, and the dispersion medium is removed, for example, by evaporation, the fabric adhering to the auxiliary surface. Finally, the fabric, carrying a thin coating of rubber, is removed from the auxiliary surface. The auxiliary surface may consist of an endless member at one point of which a rubber dispersion is continuously deposited. The fabric is brought into contact with the coated surface and caused to travel with it through a heating device. The dried material is removed continuously and wound on to a roller. Fabric-lined rubber gloves may be produced by making the coated fabric into a glove, which is placed upon a former with the rubber dressing outside, and afterwards dipping the assembly into a rubber dispersion and drying. The invention is described, more particularly, with reference to use of latex.

No. 551454. *Fire hose.* *M. Balkin, D. E. F. Canney, and G. Angus & Co., Ltd.* (24.12.41)

Divided out of and addition to No. 547821. Fire hose is rendered less porous by driving through it, by means of compressed air, a spreader, which expands the flat textile tube and at the same time extrudes a layer of latex or equivalent sealing agent in liquid form to form a continuous lining of sealing agent. In practice, the method is to introduce a quantity of the sealing liquid into the hose and drive it forward by means of a wood or metal plug of slight taper. The compressed air is used at relatively low pressure. The process allows the use of textiles for fire hose which would otherwise be much too porous.

No. 551740. *Straps of webbing.* *L. Harral and Dunlop Rubber Co., Ltd.* (6.11.41)

The end of a strap intended for use with a buckle is coated with rubber to prevent the strap from fraying. The rubber may be applied by dipping the end of the strap into latex and then vulcanizing the deposited latex.

No. 553669. *Impregnation of woven hose-pipes with latex.* *F. S. Zabala.* (11.7.41; *Spain*, 12.11.40)

Hose-pipes woven from fibres are impregnated with latex. The woven hose is treated in a slightly acid bath, or some other bath that has a coagulating effect, before or after being impregnated with a moistening material. After being allowed to dry, if desired, it is arranged in an inclined position, or else one of its ends is supported at a higher level than the other. Its interior is then filled with stabilised latex containing the materials necessary for vulcanization. A moistening material may be included. The ends of the hose are then closed with cocks or other means, and the hose is maintained in this position until the latex contained in its interior has passed through its walls, for which purpose a light pressure is exerted upon the latex at the upper end by means of air or other gas, or by compressing the hose between two rollers starting from the upper end. The impregnated hose may be subjected to drying and subsequent vulcanization by passing through its interior a current of heated air or steam.

No. 554572. *Deposition of rubber on fibrous material.* *R. F. McKay, for United States Rubber Co.* (5.2.42)

To obtain uniform deposition of a latex composition on fibrous material, the composition is brought into the state of a dilute flocculent precipitate, sufficiently stable not to coalesce into coherent masses but not too stable to precipitate on fibrous matter immersed in it. The required flocculent state is obtained by adding to the latex a stabiliser and a coagulant in appropriate proportions. A long list of stabilisers is given. The coagulant may be an acid or a polyvalent metal salt.

No. 557038. *Abrasive articles.* *A. Abbey, for United Cotton Products Co.* (27.1.42)

Flexible abrasive cloths and papers are made from a plurality of superposed carded fibrous membranes with their individual fibres interlocked, interlaced, or interwoven to form a non-laminated web. The web is impregnated with adhesive binder, and the abrasive grains are lodged in the interstices of the web. Apparatus and methods for constructing such abrasives are given in detail. Resilient abrasives are obtained, avoiding "chatter" on a work piece, by the use of a latex adhesive.

No. 557420. *Knitted and woven fabrics. H. E. Brew.* (15.5.42)

In No. 538865 a process of obtaining ladder-resistant knitted fabrics is described consisting in using two or more filaments twisted together, one at least being potentially adhesive, subsequently treating the fabric to render the filament actually adhesive to unite contacting elements. This idea is amplified in the present patent by using a single filament which is intermittently potentially adhesive. Filaments or the kind is obtained by coating intermittent zones with rubber solution or latex. The fabric made is then ultimately treated with a solvent to swell and soften the rubber and render it tacky. Rubber is particularly desirable as the adhesive as it enhances the fabric elasticity. Advantage is taken to have the fabric and rubber oppositely charged when depositing the rubber on the textile, as by the use of cationic substances in appropriate cases. A vulcanizable or vulcanized latex may be used.

No. 557611. *Textile fabrics. H. E. Brew.* (15.5.42)

Divided out of No. 557420. The process of No. 538865 (see No. 557420) is improved by using latex as the adhesive. The rubber is deposited from latex by using the principle of opposite charges on the textile and on the rubber particles. Cetyl pyridinium bromide is suggested as a suitable cation-active substance for this, and the textile is treated with this alone in the first place. Then, after weaving or knitting, when the fabric is passed through a latex bath, rubber is deposited only where the cationic soap has entered. Anion-active bodies can be used similarly in suitable cases, and where mixed textiles are used in a fabric, both types of ion-active material may be employed on the appropriate yarns. Adjustment of the quantity of active substance applied to the fabric can be used to control the proportion of rubber brought into the fabric.

No. 557820. *Pile fabrics. Behr-Manning Corporation.* (3.6.42; *U.S.A.*, 4.6.41)

Difficulties in applying fibres to adhesive layers on a fabric base to form pile fabric, especially when using latex as the adhesive, occur because: (1) the first occurring fibres absorb water or solvent rapidly from the adhesive, thus presenting a more viscous surface to fibres arriving later, and causing differences in penetration and pile length; (2) the immersed ends of the fibres tend to draw together giving a "clump" effect. These difficulties are overcome by applying the fibres first to a relatively weak adhesive layer on a transfer apron, thus holding them equally immersed and lightly bonded together in a closely packed oriented relation. The whole layer so formed can then be pressed into the adhesive on the backing fabric in a uniform way. Pile fabric made in this way has the pile of even length, and all of it securely embedded in the holding latex adhesive. The method lends itself readily to forming the preliminary sheet on the transfer apron with various areas of fibres laid out in patterns. Apparatus for working the process is described in great detail.

No. 558449. *Fire hose. E. E. Hardy-Birt and G. Angus & Co., Ltd.* (8.7.42)

A process for eliminating or reducing the porosity of fire hose is described. A pool of latex is maintained in a length of the hose by mechanical means. Relative movement between the hose and the pool-maintaining means is effected so as to traverse the pool through the hose with the treated portion of the hose moving upwards in relation to the pool. The treated portion acquires an internal coating of latex of thickness determined mainly by gravity and the viscosity of the latex. The treated portion is maintained in an open condition and dried sufficiently to permit the hose being flattened without adhesion of the interior wall. The weight of the product is less than that of hose provided with a thick rubber lining.

No. 559986. *Bonding rubber to fabric. United States Rubber Co.* (2.11.42; *U.S.A.*, 8.11.41)

Rubber is bonded to fabric containing cotton, as required in the production of tyre casings, hose, and belting, by applying to the fabric a coating of a latex composition. The latex contains a quaternary ammonium compound in which one valency of the nitrogen is satisfied by an anion and the remaining valencies by hydrocarbon radicals consisting of alkyl radicals having less than 6 carbon atoms, aryl radicals, aralkyl radicals having less than 4 carbon atoms in the side chain, and hydrocarbon radicals in which 2 carbon atoms satisfy nitrogen valencies and form with the nitrogen part of a heterocyclic nucleus. The coating is dried and a vulcanizable composition is applied to the coated fabric. The composite structure is subsequently vulcanized. The following are suitable quaternary ammonium compounds: benzyl pyridinium chloride, tetraethyl ammonium chloride, and trimethyl benzyl ammonium hydroxide. Because of the addition of such compounds, the products have improved flexing resistance.

No. 560893. *Pneumatic tyres. Firestone Tire & Rubber Co.* (7.7.41; *U.S.A.*, 5.6.40)

The tyre is made directly from latex. Tyre fabric is impregnated with a latex composition and a coating of rubber composition is deposited directly from heat-sensitised latex composition on to the impregnated fabric to produce a skim coating. Tyre plies are formed from the impregnated and coated fabric. A heat-sensitised compounded latex is gelled and dried to produce unmasticated rubber in the form of a tyre tread. The tyre plies and tread are assembled with beads and other necessary parts to form a pneumatic tyre, which is then vulcanized.

No. 561731. *Outsoles, and sheet material therefor. Rope-Soles, Inc.* (18.2.43; *U.S.A.*, 1.4.42)

Soles are formed from strips of braided rope disposed in adjacent side by side relation and extending transversely of the sole and secured together, as by layers of latex interposed between adjacent strips. The latex may be applied by a frictioning operation.

No. 563213. *Sheet material. F. S. Roberts and Revertex, Ltd.* (2.12.42)

Sheet material or moulded products are made from comminuted fibrous material such as ground leather scrap by converting the fibrous material into a slurry with water, incorporating with the slurry a water-miscible dispersion of a binding agent, adding a flocculating agent for the binder, and immediately afterwards adding a wetting agent. In this way the attraction of the fibres of the comminuted fibrous material for the flocculated binder is increased and an even distribution of the flocculated binder over the entire surface of the fibres is ensured. A suitable binding agent is vulcanized or unvulcanized latex.

No. 564673. *Impregnating hose-pipes woven from natural or synthetic fibres. F. S. Zabala.* (6.7.43)

Addition to No. 553669. No. 553669 is modified in that the woven hose-pipe, treated with a wetting agent, is lodged in an inclined or vertical position in a pulverulent material that has a coagulating effect upon latex, for example, alum, citric, or talc impregnated with an acid. The hose is then filled with a compounded latex, the ends of the hose for this purpose being closed or provided with cocks. Compressed air or a gas under pressure is injected into the hose from the upper end, the pressure being maintained until the impregnating liquid issues to the outside through the pores of the hose.

No. 567296. *Artificial fibrous sheet material. J. Pickles and R. Pickles.* (22.2.44)

A mass of waste vegetable textile fibre is carded into a dry web or fleece, at least 90 per cent. of the fibre not exceeding 2 mm. in length and the rest not exceeding 10 mm. The mass is then impregnated, *e.g.* by spraying with an aqueous binding agent (50–20 lb. of dry binding agent per 50–80 lb. of fibre). Finally the mixture is compressed into sheets and dried to give comparatively stiff boards. Specially suitable fibre is the waste cotton flock from cloth-raising machines, and the binding medium may be latex, in which case compression into sheets is done in hot presses to vulcanize the rubber. Reference is made to Nos. 440396, 424098, and 536012, which describe similar processes, but all three of which start with pulped fibre.

No. 567423. *Rubberizing fabric. Firestone Tyre & Rubber Co., Ltd., for Firestone Tire & Rubber Co.* (12.11.42)

The process is used in the production of fabric or plies for incorporation in pneumatic tyres or rubber belts, the fabric being impregnated with an aqueous protein-rubber dispersion, for example, a casein-latex dispersion as described in No. 546171, which is afterwards dried and heated to a temperature greater than 100° C. In the present process, the initial drying of the impregnated fabric is effected in such a way as to prevent streaking of the fabric due to gelling of a portion of the protein-rubber dispersion thereon while the fabric is wet, by conveying the impregnated fabric through a drying chamber over internally cooled ridges whereby contact of the wet fabric with the conveying mechanism during drying is maintained at a minimum.

No. 573344. *Compound fabrics. H. L. Byrd, G. W. Robinson, and Drey, Simpson, & Co., Ltd.* (27.10.42)

Shock-absorbing compound fabrics are made by taking two sheets or layers of warp-pile fabric having a pile of mohair or wool with the pile "finished" in the usual way, or alternatively one sheet or layer as above and the other sheet or layer of plain cloth "raised" on one side. The two layers in either case are impregnated with latex and secured together, pile to pile in the first case, pile to raised surface in the second case. Compound sheets thus built up may be further built up by latex bonding in the same way. The built-up blocks have the shock-absorbing characteristics of sponge rubber. The material is specially appropriate for padding, cushioning, upholstering, and shock-absorbing in furniture and its fittings, and in these applications not only sheets or layers, but rolls, rods, bars, and rings of various cross-sections may be built up and used with advantage.

No. 575379. *Treatment of fabrics to render them resistant to noxious gases, vapours, and liquids. R. Kingan, J. W. C. Phillips, and B. H. Wilsdon.* (21.5.40)

A finely divided absorbent substance, for example, activated charcoal, bentonite, Levillite, or alumina is applied to textile material. When necessary, the substance is fixed to the material by means of a binder or by application of one or more layers of other material. The products are suitable for making anti-gas curtains or garments for decontamination workers. Latex is included in many examples of suitable binders. If latex is used it is advantageous that it should be rendered electrically charged in the opposite sense to the textile fibres.

No. 577284. *Stiffened material. A. H. Stevens, for Armstrong Cork Co.* (6.12.41)

In making a shoe stiffener, a porous, absorbent base, for example of paper, felt, or fabric, is impregnated with a homogeneous mixture of a synthetic resin and a resilient substance, preferably latex. The resin is one which has been stabilised in incompletely condensed, water-soluble and/or alcohol-soluble condition, and which is capable of activation to an infusible, insoluble stage. Vulcanizing ingredients may be incorporated in the latex or vulcanized latex may be used. Particular reference is made to the use of urea-aldehyde resins in the process, but these may be replaced by thiourea-aldehyde, melamine-aldehyde, or phenol-aldehyde resins. After impregnation of the base, the material is dried and furnished to the shoe manufacturer in sheet form or as blanks. Before use, the blank is moistened with a solution designed to activate the condensation of the incompletely condensed resin.

No. 577982. *Drying of textile material. J. W. Illingworth and Dunlop Rubber Co., Ltd.* (1.4.43)

Textile materials, such as fabrics, cords, or yarns which have been impregnated or analogously treated with aqueous preparations containing resin-forming substances, are dried by subjection to contact with superheated steam at atmospheric pressure to dry the materials to a condition in which they are readily handleable and devoid of undue tackiness. The drying process may be applied to rayon cord which has been treated with a latex composition containing a synthetic resin. The process may be used in association with that of No. 577985.

No. 577985. *Rubberized fabric for use in tyres, belting, and the like. J. W. Illingworth and Dunlop Rubber Co., Ltd.* (28.4.43)

The rubberized fabric is made by treating a ply of textile material with an aqueous preparation of an adhesive for rubber, drying the treated fabric by passing it through an atmosphere of dry steam, for example, as described in No. 577982, and calendering a layer of unvulcanized rubber composition on to the textile material thus conditioned. The process is continuous. Adhesives for use in the process may be based, for example, on aqueous solutions or dispersions of phenol-aldehyde resins and may contain latex.

No. 580134. *Treatment of fabric. International Latex Processes, Ltd.* (18.5.44; *U.S.A.*, 27.5.43)

Previous patents for depositing rubber and water-insoluble synthetics on knitted stockings and similar fabrics are Nos. 403121, 403394, 508136, 508137, and 554572, and U.S.Ps. 2173241, and 2173243. According to the present patent, the fabric is immersed in an aqueous dispersion of the treating material, the treating material deposited by coagulation, and the treated fabric rinsed in a cation-active aqueous bath. In an example, coagulation was effected simply by stirring the fabric in the latex, *e.g.* for one hour. All the separate parts of the process are well known, but the order of application of the steps is claimed to be new, and gives improved results.

No. 580813. *Ornamenting fabrics. A. W. Mycroft and W. Mycroft.* (28.1.44)

Textile fabric is ornamented by a process involving the attachment of a finely divided material to the fabric by means of a latex or other adhesive.

No. 586762. *Belting. W. S. Short, G. A. Sowerby, and G. Angus & Co., Ltd.* (16.8.44)

The use of knitted fabric for the manufacture of belting confers several advantages, not the least of which is the power to effect a homogeneous join of parts which may be of any length. It is known, see No. 586786, to produce a belting from knitted fabric treated with rubber by vulcanizing the belt while stretched to such an extent that it will not lengthen further during service. This, however, involves an inconveniently large stretch, *e.g.* up to double the length of the unstressed material. It is now claimed that the desired result is obtained by impregnating the fabric with rubber latex or solution, stretching while wet, and allowing the impregnant to dry and harden, thus retaining the fabric in its stretched condition. The belt is subsequently press-vulcanized. Reference is made to No. 469797.

No. 586786. *Belting. W. S. Short, G. A. Sowerby, and G. Angus & Co., Ltd.* (16.8.44)

Divided out of No. 586762. Belting is made from knitted fabric which has been impregnated with rubber latex or solution, and which is then vulcanized in a press while in an extended state to decrease tendency to stretch in service. Use may be made of the composite textile and rubber yarn sold as "Filastic" and described in Nos. 338381, and 344414. The rubber being vulcanized resists the tendency of the fabric to relax and retains it in the extended condition. Reference is made to No. 469797.

No. 606513. *Impregnated fabrics. Etablissements Colmant & Cuvelier Soc. Anon.* (10.7.45; *Belgium*, 29.3.41)

Impregnated fabrics, especially multi-ply fabrics, are produced by providing the fabrics during weaving with cores in the form of binding threads, so formed and arranged as to be easily removed from the fabric to leave holes. These holes facilitate impregnation; when the core threads have been removed, the fabric is impregnated with latex. After complete drying, the fabric is vulcanized with or without an outer coating of rubber. The product can be used for belting.

No. 624113. *Carpets. J. E. Woolley and Vol Crepe Ltd.* (14.11.47)

Carpets are provided with a backing of sponge rubber by applying a layer of a latex or masticated rubber composition containing a blowing agent to the back of the carpet, and then heating the layer by infra-red lamps to decompose the blowing agent and vulcanize the rubber.

No. 637227. *Coated fibres of cellulosic material and felted fibrous cellulosic material embodying same. American Cyanamid Co.* (9.5.46; *U.S.A.*, 13.7.45)

An aqueous dispersion of a coating agent comprising a wax, a bitumen, a gum, resin, elastomer, or thermoplastic or thermosetting resin is added to an aqueous fibre suspension in water in deflocculated condition. The agent is then flocculated by the action of a colloidal dispersion of cationic melamine-aldehyde resin. The fibre may be paper pulp which is then coated with *e.g.* latex.

No. 638090. *Treatment of textile fibre. C. M. Blow and British Rubber Producers' Research Assn.* (31.7.47)

This invention relates to the treatment of textile fibre or paper for the application thereto of pigments and dyes, which may be insoluble or slightly soluble in water, waxes and metallic soaps for imparting water-repellency, moth-proofing agents, insecticides, and bactericides. The substance is dispersed in an aqueous solution of a cationic soap so that the particles carry a positive charge. The dispersion is then mixed with a latex or rubber dispersion which has been treated with a cationic soap so that its particles also carry a positive charge. The mixed dispersion is then brought into contact with the material so that the water-insoluble substance and rubber are deposited thereon. DDT may be applied by this method.

No. 644648. *Carded fibrous materials. C. M. Blow and British Rubber Producers' Research Assn.* (15.3.48)

Carded fibre in thin web or sliver form is treated with a spray or mist of dilute, stabilised latex so as to deposit discrete droplets of liquid on the fibrous web. The amount of latex applied is insufficient to produce a continuous film of latex over the surface of the web, so that on evaporation of the moisture from the latex, the rubber particles on the web are sufficient to effect a bond between the fibres at their points of intersection but are insufficient to produce a continuous film of rubber over the web. The solids content of the latex is less than 10 per cent. and may be as low as 0·5 per cent. The products may be used for quilts, upholstery pads, mattresses, pillows, clothing pads and floor coverings. Reference is made to No. 497793.

No. 646422. *Porous fibrous products. A. Talalay.* (1.7.46; *U.S.A.*, 26.1.46)

It is a known process to treat hair with latex to bond the hair into a porous mass for use in upholstery. According to the present patent, wool or a fibrous material having substantially the normal fibre size and kink and kink characteristics of wool is used instead of hair. The wool is picked on a standard textile picker and is then carded out to produce a very thin and open-mesh web. The web is sprayed with latex from one side and dried, and then from the other side and dried, and is then dipped in dilute latex, the surplus liquid allowed to drain off, and the web again dried. Layers of the treated web material are then plied up with the aid of a latex cement to the required thickness. The structure is then vulcanized and simultaneously moulded under light pressure to the required shape, if desired. The amount of rubber in the finished product is greater than the amount of wool. Examples of fibres which may be used instead of wool include crimped fine denier rayon and crimped casein fibres.

No. 648331. *Imitation leather. A. Kemp and Underfelts, Ltd.* (12.12.47)

An intimate mix of fibre particles with latex is made and is then filtered, as through a wire screen, to leave a mat in sheet form, but the invention relates to the method of controlling the charge on the rubber particles. This is kept substantially neutral and is obtained preferably by adding positively charged latex, *e.g.* Positex, to ordinary negatively charged latex. By this means the coagulum is obtained not as a lump but as a filterable suspension of flocculent rubber.

No. 650936. *Apparel pad. J. A. Talalay.* (14.4.47; *U.S.A.*, 17.6.46)

An apparel pad of concave-convex shape has its thickness graduated from a thick portion to a surrounding relatively thin marginal portion, and comprises parts attached to one another. Each part comprises a stereo-reticulate mass of unwoven fibres individually coated and bonded to one another at their crossing positions by an elastic bonding substance such as latex.

No. 653461. *Laminated felt. A. Kemp and Underfelts, Ltd.* (10.6.48)

A method of making laminated felt consists in attaching a backing hessian or like open-weave material to one surface of each of two layers of felt, coating the non-backed surfaces with an adhesive latex composition, pressing the coated surfaces together so that they adhere, and then removing the backing.

No. 654955. *Coating or impregnating fibrous cellulosic material. J. H. Daniel, Jr., R. Hastings, C. G. Landes, and L. H. Wilson, assignors to American Cyanamid Co.* (16.12.48; *U.S.A.*, 26.12.47)

Fibrous cellulosic material such as paper pulp or cotton linters is treated with a cationic resin, and then with latex or other specified aqueous dispersion. The cationic resin flocculates the latex and thus causes deposition of a substantial proportion of the solids of the latex on the fibrous material.

No. 655540. *Flexible felted fibrous abrasive webs. A. Abbey, for Carborundum Co.* (24.12.48)

Abrasive web material is made by forming an aqueous suspension of fibrous material containing 0·5–5 per cent. of fibres, and depositing the suspension on a foraminous support so as to form a web saturated with aqueous liquid. Abrasive particles in a proportion of 70–85 per cent. by weight of the abrasive web are caused to enter the interstices between the fibres over a required area of the web. An adhesive binder such as latex may be introduced into the aqueous suspension or into the web while it is on the support, or the abrasive particles may be coated with adhesive prior to their introduction into the web.

No. 659088. *Production of unwoven fabrics. West Point Manufacturing Co.* (29.7.48; *U.S.A.*, 18.11.47)

A machine for manufacturing unwoven fabrics comprises a device supplying fibres to a fibre-transfer duct traversed by an air current which carries the fibres to a foraminous member on which they are deposited by the current to form a matted web. The fibre supply device has a velocity ratio of at least 500 between the feed-in speed of the fibres to the device and their speed of delivery by the device to the transfer duct.

•No. 668842. *Porous resilient articles of fibrous materials. Velatex, N.V.* (20.12.48; *Netherlands*, 30.12.47)

A loose fibrous mass is immersed in a bath of latex so that the fibres are distributed throughout the liquid. A coagulant is added and the contents of the bath are subjected to vibration during coagulation of the latex to prevent mass coagulation. A resilient latex-bonded hair is obtained. The process is applicable to the treatment of hog's hair having a length of 2–4 cm., whereas hitherto favourable results have been obtained only with firm and curled fibres such as horsehair.

No. 670334. *Manufacture of pile fabrics. P. Shaw.* (15.11.48; 20.1.49; 23.3.49)

Pile yarn is wound on channelled formers and served to a foundation by vulcanization under pressure, during which process the rubber or other plastic substance forming the foundation is forced to flow through the channels in the formers. The pile may be looped or cut.

No. 674922. *Pile fabric. G. C. Ahier, A. V. Champagnat, and J. F. M. Tirmont.* (31.12.47; *France*, 3.1.47)

Pile fabric, particularly carpet fabric, is made by forming chenille threads, spaced from one another transversely, into a sheet with all the pile on the same face and then sticking the other face of the sheet on to a support, the transverse spacing of the chenille threads being such that the support is completely covered by these threads and presents the appearance of a carpet. The adhesive may be latex to which vulcanizing ingredients may be added. The pile fabric may have a backing of rubber or sponge rubber.

No. 677928. *Method and apparatus for making a fibrous web for the manufacture of non-woven fabric. Johnson & Johnson (Gt. Britain) Ltd.* (23.2.50; *U.S.A.*, 23.2.49)

A substantially isotropic fibrous web for the manufacture of non-woven fabric is made by inducing turbulence into an air stream, continuously and progressively removing fibres from the advancing edge of a feed of fibres, and introducing them into the turbulent air stream downstream of the place where turbulence has been induced. The movement of the fibres in the direction of the air flow is subsequently stopped while the air stream is permitted to continue so as to produce a web, the web being then removed from the air stream.

No. 693711. *Flexible web or sheet composed of fibrous materials agglutinated by adhesives. International Cellucotton Products Co., assignees of K. J. Harwood.* (21.11.50; *U.S.A.*, 4.8.50)

A flexible, porous, fabric-like sheet material comprises a web of fibres which has had its porosity increased by stretching to separate the fibres and has been strengthened by the application of a number of lines of adhesive material.

Appendix I

NOTE ON THE DESIGN OF EQUIPMENT FOR THE LATEX TREATMENT OF TEXTILES

GENERALLY speaking, the equipment required cannot be "borrowed" from the rubber industry or the textile industry without some modification. The object of this note is to draw attention to certain facts and conditions that must be taken account of when considering equipment for use with latex.

First and foremost there is the warning, that is never omitted, that on no account must copper or copper-containing metals be used in contact with the latex or wet rubber deposit. Copper in minute amounts can catalyse the oxidation of the rubber, and the result can be catastrophic. Strange as it may seem, the most stainless-steel-looking equipment will often be found to have brass, copper or bronze bushes, hinges, flanges, etc., in some not too conspicuous places, and it is only after bitter experience that the worker in this field comes to trust no one but himself to inspect the equipment for freedom from copper. Due to the ammonia content, copper is more rapidly dissolved by latex than by normal aqueous liquors, and this renders vigilance doubly important.

Generally speaking, stainless steel is the ideal material of construction; aluminium is perhaps second choice, but its tendency to attack by alkali is against it; tin-plate can be used, but here again the alkali content leads to attack and a relatively short life.

Appendix II

THE ESTIMATION OF THE RUBBER CONTENT OF FIBROUS MATERIAL

By means of weight changes during processing, fairly accurate estimates of the amount of rubber applied can often be made, provided the moisture content or condition of the fibre is either known or kept the same when the two weighings are made. Nevertheless, independent checks by direct analysis are often necessary; particularly when small amounts are applied these methods are more reliable.

The estimation has several difficulties, and no one method can be adopted on account of the difference in behaviour of the various fibres. The fibre may consist of protein matter such as silk, wool or other animal fibre, and leather, or cellulosic matter such as jute, cotton, rayon, paper, kapok, etc. The rubber may be vulcanized or unvulcanized. In addition to fibre and rubber, the presence of other substances such as soap, fats, waxes, oils, dyestuffs, fillers, pigments, etc., must not be overlooked. The problem of analysis appears complex but may be simplified in some cases by knowing, from the process of manufacture, the definite absence or presence of certain ingredients.

The three techniques available are now discussed.

1. The Destruction of the Fibre by a Chemical Reagent which is without effect on the rubber.

This method is applicable to protein matter which is destroyed by boiling caustic soda, a reagent that does not affect the rubber to any measurable extent.

The general method is to boil the weighed sample (1–2 gm.) in about 30 c.c. of 5%* caustic potash or soda until the fibre is completely destroyed (normally 10–15 minutes) and separate the rubber, dry and weigh it. The separation of the rubber sometimes presents difficulties. In the case of, say, a white woollen or

* A 1% solution for a longer time is recommended by some workers.

worsted yarn it is not usually difficult to filter the caustic soda solution through a No. 4 filter, e.g. in a Gooch crucible with gentle suction, and wash, remove from the paper as a pellet and dry.

Low quality woollens, e.g. carpet yarns and heavily dyed materials, are often difficult or impossible to filter on account of finely divided gelatinous substances and/or dyestuff. The method adopted is to centrifuge the caustic soda solution in a hand centrifuge, when the rubber rises to the surface and the non-rubber constituents sink. Both top and bottom layers are washed once or twice and recentrifuged to ensure complete separation. The rubber can usually then be easily collected and dried and weighed.

The same technique can be applied to leather-rubber compositions and real silk containing rubber, without any difficulties not encountered and dealt with above. A similar technique for cellulosic material, however, presents great difficulty practically.

A number of "solvents" for cellulose have been tried, but the high viscosity makes separation of rubber difficult, particularly as the rubber may be in a fine state of division. The only method that appeared at all promising was to use boiling concentrated hydrochloric acid to break down the fibre structure. Using 1–2 gm. of material, it was then found that if the hydrochloric acid was decanted off through a sintered glass, or Alundum crucible, and the slurry of degraded fibre and rubber was shaken up with 50 c.c. of water and 10 c.c. of benzene, the rubber (even if vulcanized) appeared in the benzene layer and the cellulose material could be separated off. Finally, the rubber was precipitated from the benzene by means of acetone, and filtered and weighed.

It is advisable in this method to add a small amount of oil-soluble dye to the benzene, if the rubber is not already dyed or pigmented, to make separation easier.

This method has only been found satisfactory for a good-quality cotton yarn containing up to 10% of rubber. It is not simple, and some practice is necessary to judge the optimum amount of boiling, temperature to filter and so on.

2. The Use of Solvents to remove the Rubber without affecting the Fibre

This is generally the favoured method for cotton proofings, and reference may be made to British Standard 903:1950, Part 5, where the use of solvents such as nitro-benzene is described. Ortho-nitro-anisole has also been suggested.[30]

Simple rubber solvents such as benzole, petrol, carbon tetrachloride are not reliable, since vulcanized rubber only swells in such solvents and would not be completely extracted. In the case of unvulcanized rubber, removal is more complete but the results need to be critically examined.

3. The Oxidation or, more generally, the chemical modification of the Rubber to render it more readily removable from the Fibre by extraction with a Solvent or by emulsification with a Detergent.

The difficulty of destroying cellulosic material without affecting the rubber and the fact that simple extraction by solvents is slow and not always reliable have led to the development of a method of modifying the rubber chemically (viz. oxidation) so that it can be readily removed from the fibre.

Oxidized rubber is dispersed or dissolved in caustic alkali and is soluble in acetone; and, furthermore, it has been found to be readily and completely removed from textile material by a simple soap and soda scour. To bring about the oxidation, a catalyst is added. This may be cobalt or copper naphthenate, linoleate or stearate applied either as a dilute solution in carbontetrachloride or benzene, or as a dilute emulsion in alkali (e.g. ammonia); 1–2% of the catalyst by weight on the dry material is required.

The following is a formula for a suitable emulsion:

Cobalt linoleate	10 gm.
"Sextol"	20 c.c.
Ammonia 1%	20 c.c.
"Vulcastab LS" 1%	5 c.c.

Diluted to 1 litre for use.

If the material is finely divided and air can be made to reach all the surface readily, oven heating at 70° C. for 1–2 hours is usually sufficient to oxidize completely in the presence of the catalyst.

As an alternative, hydrogen peroxide appears the best oxidizing agent to use since it leaves no residue to complicate subsequent determinations. The rubber-containing material can be steeped in 20–40 times its weight of 3–5 volumes H_2O_2, warmed to 50–60° C. and maintained there for 15–30 minutes, and then, if necessary, filtered or evaporated to dryness before passing to the next stage, which is the separation of the fibre from the oxidized rubber.

We have two alternative methods:

Firstly, as stated above, the oxidized rubber can be removed by boiling either with 1–2% caustic soda solution or with dilute sodium carbonate solution (0·1–0·2%), with or without the addition of a small amount of sodium oleate. The rubber having been oxidized and dispersed, the fibre can be then collected, washed, dried and weighed. Whether sodium hydroxide or sodium carbonate is used will depend on the fibre involved.

Alternatively, the oxidized rubber can be extracted with acetone, after which the fibre or the extract can be weighed. It may here be pointed out that, provided due attention is paid to the moisture content of the fibre, it is preferable to confine one's weighings to the fibre since the rubber will contain a rather indefinite percentage of oxygen.

The material to be analysed should be as finely ground or cut as possible. It should be noted that textile material takes up water in amount related to the atmospheric humidity, and since this so-called regain may range from 0–20% this is an important point. Drying of all textile material at 90–100° C. for 1–2 hours and weighing in closed vessels is perhaps the most satisfactory technique, the textile material, after removal of rubber, being similarly dried before weighing.

It is taken as essential to acetone extract it prior to any determination. Acetone will remove oils, fats and much of the waxes and organic dyestuffs and oxidized rubber, but will not affect unchanged rubber—vulcanized or unvulcanized. When a soap-and-soda scour or caustic soda treatment is to be given as part of the determination of rubber content, an alkaline water-extraction is also necessary; protein, soaps, soluble coagulants, starches, etc., will thus be removed.

In the case of rubber-destruction methods, the separation of the fibre from emulsified oxidized rubber may present problems. It is advantageous to centrifuge the solution to separate the fibre, which is subsequently washed (in the centrifuge) and then filtered. This latter separation can often be carried out in a Gooch crucible, using the fibre to form its own filtration pad. The fibre, after drying and weighing, is checked for purity by ash determination.

Where the oxidized rubber is to be estimated by acetone extraction, the fibre can be filtered direct into the thimble.

The acetone and water-insoluble non-fibre and non-rubber constituents will appear in the rubber in the case of fibre-destruction methods and, therefore, the purity of the rubber must be checked by ash determination.

Corrections for added cobalt or copper salt must be made.

Appendix III

THE QUALITATIVE ASSESSMENT OF THE DISTRIBUTION OF RUBBER THROUGHOUT A TEXTILE MATERIAL

APART from the quantitative estimation of the rubber content of fibrous material as discussed in Appendix II, it is often important to have a qualitative assessment of the way the rubber is distributed, e.g. the degree of impregnation, or uniformity.

For this it is necessary to prepare sections of the material for examination under the microscope. Two steps are involved: firstly, the cutting of the section, and secondly, the differentiation of the rubber from the fibre. To cut the sections of the required thinness the material may either be embedded in rubber and treated with polysulphides according to the methods of Grenquist and Dieterich[31] so as to vulcanize to the ebonite stage, or embedded in paraffin wax and cooled with carbon dioxide snow according to the preferred method of Hauser and Huenemoerder.[4] Sections are cut on the microtome and mounted on microscopic slides and photographed. The application of concentrated sulphuric acid for about two hours destroys the non-rubber material, leaving a skeleton of rubber from which the degree of impregnation can be deduced.

When rubber is applied to textile material in small quantities as a finish it is of importance and interest to study the uniformity of deposition not only throughout the thickness of the fabric but over its area or along the length of a cord or yarn.

One method with undyed textile is to use a latex containing suitable dispersed pigments or oil-soluble dyes, in which case examination of the treated material, under a binocular microscope if necessary, will show at once the uniformity of deposit. This may not always be convenient or possible, and dyeing the rubber after it has been applied to the textile is quite a useful technique. The essential principle is to use a dye that is soluble in the rubber

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