July 24, 1956 I. BARNETT 2,755,534

MAKING A DYED FLAMEPROOF FABRIC

Filed Nov. 21, 1951

Fig. 1.

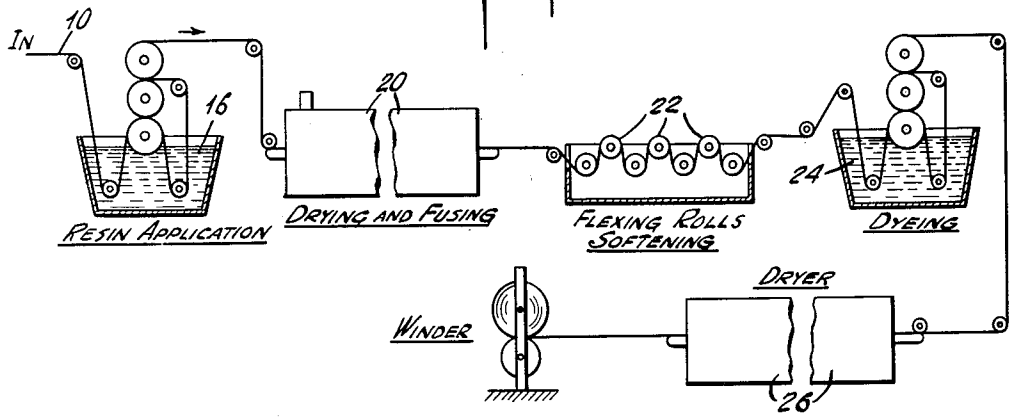


Fig. 2.

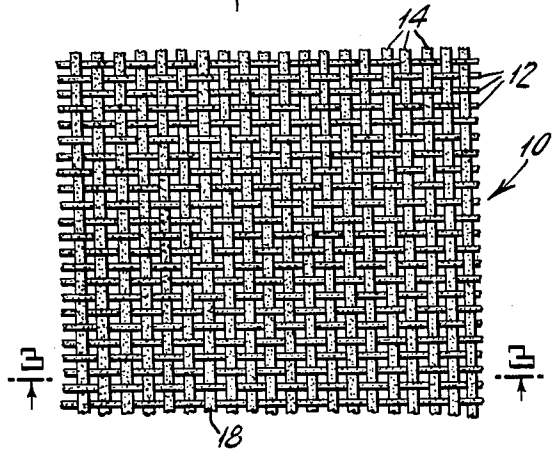
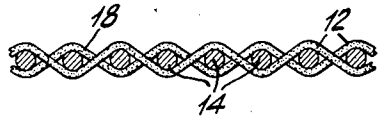


Fig. 3.



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MAKING A DYED FLAMEPROOF FABRIC

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3 Claims. (Cl. 28—74)

This invention relates to dyed, woven, flameproof fabrics and is particularly concerned with evenly dyed, cellulosic fiber-reinforced asbestos fabrics of light weight which are washable and durably flameproof, and to a method of manufacturing such fabrics.

This application is a continuation-in-part of my copending application Serial No. 131,000, filed December 3, 1949, now abandoned.

For the production of flameproof woven fabrics suitable for draperies, theater curtains, and the like, it has been heretofore deemed necessary to employ yarns incorporating at least 80% by weight of asbestos in both the warp and filling directions. Such a fabric generally comprises up to 20% of cotton fibers as reinforcement and is accepted by Underwriters Laboratories as a flameproof fabric. It has the disadvantage, however, of being heavy, bulky and inflexible and thus does not have the draping characteristic desired for most installations. Asbestos fabrics formed entirely of such asbestos yarns also suffer from a characteristic of relatively poor tensile strength in the yarns due to the inherent short length of asbestos fibers. It is desirable, therefore, to utilize a greater percentage of reinforcing fiber in such yarns and fabrics. Since cellulosic fibers are, of course, inflammable, such cotton-reinforced asbestos fabrics have not been suitable for their intended use due to the loss of the desired flameproof characteristic. It was considered that the asbestos present in such cotton-reinforced fabrics, and particularly in a fabric woven with 100% cotton in a warp or weft relationship, would act as a barrier to the flame, preventing its movement from one cotton yarn or fiber to the next. This action is not attained, however, probably due to the fact that asbestos, while not inflammable, is a good conductor of heat. It has been found that a cotton-reinforced asbestos fabric of a substantial cotton content has, in fact, substantially the same rate of burning and propagation or movement of flame from yarn to yarn as does a 100% cotton fabric.

Attempts have been made to overcome the flammable characteristic of cellulosic fiber-reinforced fabrics. It has been proposed to form a fabric from asbestos yarns containing up to 25% of cotton fibers. This fabric has a small amount of added strength and flexibility, due to the increase in cotton content over an Underwriter's grade fabric, but the so formed fabric is not flameproof. It was proposed to treat such a fabric with a flameproofing composition to overcome this condition, and a flameproofing composition comprising common flameproofing compounds and a metallic soap binder was used. Such a treatment rendered the fabric relatively flameproof immediately after application, but the fabric was not durably flameproofed. Washing or cleaning of the fabric resulted in the removal of this flameproof characteristic, and hence the fabric was unsuitable for its desired functions. It is obvious that the fabric must be capable of being cleaned or washed if it is to be used for drapes, theater curtains, or the like.

For such use as drapes, theater curtains, and the like, it is necessary that a manufacturer also be able to dye the cellulosic fiber-reinforced asbestos fabric in order to obtain the required decorative effect. Asbestos yarn has an anomalous characteristic of having a strong wicking action when first wetted, but having a filtering characteristic after the first wetting liquid is expressed out of the material and a second wetting attempted. This is probably due to the fact that asbestos fibers are of relatively short length and the first wetting results in a matting down of the short fibers to a paper-like fiber configuration. This characteristic of asbestos yarn leads to serious difficulties in dyeing since several wetting and pressing actions are necessary in a dyeing procedure. Dyed asbestos fabrics are usually characterized by an uneven, mottled effect due to clumps of substantially undyed fibers.

Accordingly, it is an object of the present invention to provide a light weight, flexible, woven fabric which is washable, dry cleanable, and durably flameproof.

A further object of the invention is to provide a light weight, flexible asbestos fabric which is dyed with color-fast dyes and which is washable, dry cleanable, and durably flameproofed.

A particular object of the invention is to provide a strong, light weight, woven asbestos fabric containing more than 25% cellulosic reinforcing fibers, which is washable, dry cleanable, and durably flameproof, which may be evenly dyed with color-fast dyes, and which exhibits substantially greater strength, flexibility, and wearing properties as compared to 80–100% asbestos fabric, even though of substantially lighter weight.

Additionally, it is an object of the invention to provide a fabric which has suitable light weight, strength, and flexibility for use in decorative drapes and may be repeatedly washed with water or dry cleaned with conventional solvents, without losing its flameproof properties.

With the above objects and features in view, the invention consists in the improved light weight, washable, durably flameproof fabric and method of manufacture which are hereinafter described and more particularly defined in the accompanying claims.

In the following description, reference will be made to the attached drawings in which:

Fig. 1 is a diagrammatic flow diagram of the principal steps of the present method for successive treating and dyeing light weight, woven, reinforced asbestos fabrics to impart washable and flameproof properties;

Fig. 2 is a magnified face view showing a light weight, woven fabric of somewhat open weave, for better illustration, with 100% cellulosic fiber warp yarn and asbestos weft yarn; and

Fig. 3 is a magnified cross-section of the fabric of Fig. 2, taken on the plane 3—3 of Fig. 2.

The fabrics of this invention are sufficiently light weight and flexible to be adapted for use as interior draperies. The fabrics have suitable tensile strength to adapt them for conventional high speed loom manufacture. The preferred fabrics are also sufficiently closely woven to be substantially light impermeable.

In order to obtain a durably flameproof fabric as a final product, the fabric woven and subsequently treated must contain a substantial weight proportion of asbestos. I have found that this proportion of asbestos in the fabric must be at least approximately 30% by weight of the fabric. It may be appreciated that the asbestos content may range up to 100%, but such a total asbestos fabric does not require flameproofing treatment. I am primarily interested in rendering durably flameproof fabrics containing greater than 25% cellulosic fiber by weight, since such fabrics have desirable features but do not have the flame-

proof characteristics required to satisfy the existing fire tests such as outlined by the A. S. T. M. and the governmental fire laws such as those of New York city and the U. S. Coast Guard. I have found that fabrics which have the most satisfactory combination of characteristics of durable flameproofing, flexibility, light weight, etc., have an asbestos content of approximately 55–73% by weight. The fabrics of my invention may be woven of reinforced asbestos yarn in both the warp and weft, but my preferred fabrics are woven with 100% cellulosic yarn in either the warp or filling direction, the other yarn comprising the asbestos yarn. The asbestos yarns in the latter case are preferably 80–100% asbestos by weight.

The preferred fabric is illustrated in Figures 2 and 3 and comprises a fabric **10** employing 100% cotton yarn warp threads **12** and 80–100% asbestos yarn weft threads **14**, woven with conventional weave constructions. A suitable fabric, for example, is one containing 16 cut asbestos filling yarn (i. e., with yarn count of 1600 yards per pound) and 30's/2 cotton warp yarn (i. e., two-ply or two-thread yarn measuring 30/2 x 840 yards per pound), weighing 0.7 lb./sq. yd. Such a fabric contains approximately 66–69% asbestos.

Since the untreated base fabrics of the present invention incorporate a relatively high proportion (up to 70% by weight) of cellulosic fibers, such as cotton, rayon or the like, chiefly as all cellulosic yarn in the preferred fabrics, they do not have flame-resistance, and in fact, are flame-supporting. By the present invention these fabrics or the asbestos yarn from which they are woven are chemically treated to impart to the fabric permanent, durable flameproof properties and stability in the presence of water or common dry cleaning solvents. In other words, the fabrics of this invention will withstand repeated washing with water or common dry cleaning solvents without loss of flameproof characteristics. By "flameproof" is meant the property of resisting destruction by combustion due to flaming or afterglowing after the removal of the igniting flame.

Flameproofing compositions for use in the treatment of the fabrics of my invention comprise inorganic flameproofing compounds, together with a thermoplastic resin of a composition containing chlorine. Various inorganic compounds are generally recognized as capable of rendering inflammable fibers flameproof. Such compounds are recognized as a class of materials as is illustrated by the American Chemical Society Monograph Series No. 104, 1947, by Robert W. Little and entitled "Flameproofing Textile Fabrics." Such flameproofing compounds are further classified as flame-retardant compounds and afterglow-retardant compounds, and mixtures of each are normally utilized in a flameproofing composition. Preferred inorganic flameproofing compounds for use in this invention include diammonium phosphate, mixtures of boric acid and borax and oxides or salts such as antimony oxide, stannates or tungstates. The flameproofing compounds which are utilized should either be water-insoluble per se or at least convertible to water-insoluble materials during the course of the treatment.

As set forth above, the flameproofing composition of this invention also includes a water-insoluble, solid, colorless thermoplastic resin containing chlorine. This resin serves several cooperating functions, as will be more particularly described hereinafter. One of these functions is, however, the capacity of the resin to enter into the chemical reaction which results in the flameproofing of the fabric. It is commonly considered that the propagation of flame in a cellulosic material is due to the inflammability of the tars formed from the thermal decomposition of cellulose. The resin I utilize in my flameproofing composition should be capable of liberating chloride ions upon thermal decomposition. These chloride ions, together with the inorganic compounds present in the flameproofing composition, form compounds which prevent, or at least substantially curtail, the formation of the flammable tars from the thermal decomposition of the cellulose.

Suitable resins for use in my flameproofing composition include chlorinated rubbers such as Parlon, chloroprene, and polyvinyl chloride resins, including polyvinyl chloride-acetate copolymers, particularly those containing 90% polyvinyl chloride. The amount of chlorine required to be present in the resin and capable of being thermally liberated to serve the hereinbeforementioned function is dependent upon the composition and amount of the particular inorganic flameproofing compounds present in the flameproofing composition. For example, if antimony oxide is present as a flameproofing compound, the resin must be capable of thermally liberating sufficient chlorine to transform the antimony oxide to antimony oxychloride which serves to retard the formation of the inflammable tars. The resin used in the flameproofing composition also serves as a waterproof and solvent-proof binder for the inorganic flameproofing compounds and has the characteristic of tenacious adhesion to asbestos fiber when applied and cured. The resin must also be capable of being cured at a temperature below that which will adversely effect the fibers of the fabric. I prefer to cure the resin at a temperature of 290–340° F.

In the preferred embodiment of the invention a substantial amount (50–60%) of a material capable of liberating ammonia upon thermal decomposition, for example urea, is added to the dispersion bath of the flameproofing composition. The urea serves as a buffer, and it decomposes with the liberation of ammonia during heat cure, thereby inhibiting attack of the cotton by heat-liberated chlorine.

The flameproofing composition comprising the flameproofing compounds and the resin may be applied in a single step of applying the components from a single coating bath, or the flameproofing compounds may first be applied and the yarn or fabric then coated with the resin. The determination of which procedure will be followed will normally be determined by whether or not an aqueous dispersion of the resin is obtainable. In the case of polyvinyl chloride or the polyvinyl chloride-acetate copolymer, for example, a dispersion may be formed, as is known in the prior art, and the coating of the fabric or yarn with the flameproofing composition may be accomplished in a single bath. If aqueous dispersions of chlorinated rubbers are not available, a composition containing this resin may be applied by a two-bath procedure, first coating with the inorganic flameproofing compounds and then the resin.

In order to render the fabric durably flameproof, I treat the fabric in the above-disclosed methods so as to deposit on and within the fabric at least 7%, and preferably 10–25%, by weight of the yarn or fabric of dispersion solids including the resin and flameproofing compounds. Obviously, the use of greater amounts of flameproofing solids increases the flameproof properties of the fabric. Therefore, the maximum amount of flameproofing composition is dependent only upon the ability to sacrifice the other characteristics of the fabric, such as flexibility, weight, etc. I have found it desirable to maintain the dispersion bath at conditions which will enable the finally treated fabric to retain the inorganic flameproofing compounds in an amount comprising at least 4½% by weight. The exact proportion of flameproofing compounds to resin will, of course, depend upon the particular compounds and resins utilized, having particular regard to the various functions of the resin in the final fabric.

Since the fabrics of my invention are particularly designed for use as draperies, theater curtains, and the like, it is desirable that the fabric carry a decorative design and color which is fast to light, water and dry cleaning solvents. Accordingly, the next step in my method of forming the final dyed, durably flameproofed fabric is to dye either the previously woven and flameproof-treated fabric, or to dye yarns, prior to weaving,

which have been flameproofed according to my invention. I have found that I may dye the fabrics treated according to my invention with organic dyestuffs, particularly vat dyes of the type comprising derivatives of anthracene, carbazole or indigo. The dyeing procedure utilized comprises a common dyeing procedure, for example, with vat dyes, the use of a reduction vat process comprising forming the soluble reduced dye in the reduction vat, feeding it to the dye vat wherein the fabric is passed, and allowing the oxygen of the air to form the insoluble dyestuff after the fabric is removed from the vat. I have also successfully utilized a pigment padding method of dyeing, as is common in the art.

As heretofore mentioned, serious problems have been encountered in the dyeing of asbestos material, due to the above-described anomalous characteristic of an asbestos yarn or fabric. One of the most important functions of the resin utilized in my flameproofing composition is that of enabling the fabric to be dyed in level, even shades, without a mottled effect heretofore obtained with asbestos fabrics. The resin I utilize is chosen for its characteristic of good adhesion to asbestos fiber and serves the function of laying all loose lint on the asbestos yarns and of preventing loose fiber from pulling off the yarn. The use of the resin binder in the flameproofing composition on the particular base fabric of cellulosic fiber-reinforced asbestos increases the take-up of the dye throughout the fabric compared to that of an untreated fabric, resulting in the level shades. While it is commonly considered that the resins I utilize, such as polyvinyl chloride or the polyvinyl chloride-acetate copolymer, are difficult to dye, at least with conventional dyeing procedures, the use of the resin on the asbestos yarns and fabrics apparently actually increases the affinity of the yarn or fabric for the dye. The word "affinity" must, of course, be used advisedly since it is commonly used in connection with fibers or yarns which by chemical composition have a true chemical affinity for the dye. Asbestos does not exhibit such a true affinity. In the dyed fabrics according to my invention, it is believed that the dye is deposited on and held by the asbestos fibers. This holding action of the fibers and lack of matted material in the fabric of my invention is apparently due to the maintenance of the asbestos fibers in a proper yarn-like configuration by the resin coating, thereby allowing the dye to penetrate the asbestos yarn in such condition in the same nature of a dye bath take-up as would be found with other fibers. The resin thus serves this desirable function apart from the functions it serves in combination with and for the specific flameproofing compounds utilized.

An exemplary procedure and a suitable equipment for carrying out my flameproofing and dyeing procedure is shown in Fig. 1. In this procedure, a fabric **10** is given two dips in an aqueous dispersion bath **16** of inorganic flameproofing compounds and the resin. After each dip, the fabric or yarn is given a squeeze roll treatment to remove excess dispersion liquid and to insure the desired amount of pick-up. The thus applied coating and impregnant **18** is then heated in a dryer **20** to vaporize moisture and cure the resin. The thus dried, waterproofed and flameproofed fabric is then softened and flexibilized by passing it over a flexing roll assembly **22**. The flexed, flameproofed fabric is then transported to a dye vat **24**, to which a soluble reduced dye solution is fed from a reduction vat (not shown). The fabric is then rinsed and passed through a dryer **26**, after which the fabric may be packed for shipment, as, for example, by being wound to form a bolt.

The following is an example of the procedure I have utilized to obtain a specific dyed and durably flameproof cotton-reinforced asbestos fabric with my new and improved results. It is understood, of course, that the procedure is only one of those which I have found to be suitable and as an example is not to be considered to limit my invention to the particular compositions and operating conditions outlined.

Example

A plain woven, cotton-reinforced asbestos yarn having 17.5% by weight warp yarn of 30's/2 cotton and 82.5% by weight filling yarn of 1216's/1 asbestos with a weight of 0.76 lb./sq. yd. and a total asbestos content of 66–69% by weight is treated with the following flameproofing composition:

	Percent
Diammonium hydrogen phosphate	4.14
Antimony trioxide	2.19
Urea (buffer for cotton content)	15.30
Polyvinyl chloride-acetate copolymer (90% polyvinyl chloride)	3.57
Water	74.80
	100.00

The fabric is treated in a padder in which the squeeze rolls are adjusted to allow 95–105% wet pick-up of this dispersion bath. Two dips and two nips are given the fabric. After this treatment, the fabric is dried in open width at 200–220° F. and cured and fused at 290–330° F. for five to ten minutes. Based upon 100% wet pick-up, the thus treated fabric has deposited thereon per 100 lbs. of uncoated fabric:

	Pounds
Diammonium hydrogen phosphate	4.14
Antimony trioxide	2.19
Polyvinyl chloride-acetate copolymer	3.57
Urea	3.30
	13.20

The thus flameproofed fabric is then flexibilized and softened by passing it over a flexing roll assembly. The fabric is then dyed in a reduction vat procedure in the following manner. A solution of:

Ponsol Jade Green double paste (Colour Index No. 1101)	lb.	3
Water	gal.	6
Sodium hydroxide	lb.	1.2
Sodium hydrosulfite	lb.	1.2

is formed in a reduction vat and allowed to reduce for fifteen minutes at 120° F. A solution of:

Water	gal.	62
Wetting agent (sodium alkylsulfonate)	lb.	4
Sodium hydroxide	lb.	4
Sodium hydrosulfite	lb.	4
Sodium phosphate	lb.	0.66

is formed in the dye vat. One-quarter of the reduced dye solution is fed from the reduction vat to the dye vat, and the temperature is maintained at 120° F. The fabric is passed through a padder in the dye vat six times, and the remainder of the reduced dye solution is added from the reduction vat to the dye vat in one-quarter portions after each pass. The last two passes are primarily utilized for leveling the gradation of the shade and for additional exhaustion of the dye bath. The fabric is finally removed from the dye vat and rinsed successively with water and with a 1% solution of acetic acid in water, and finally again with water to remove traces of the acid. The fabric is then dried in open width at 200–220° F. A durably flameproof, levelly shadded, jade green-dyed, cotton-reinforced asbestos fabric is attained.

Various resins have been heretofore utilized in conjunction with flameproofing compounds for the purpose of treating fabrics composed of 100% cotton yarns. Such flameproofing compositions, including those I have found suitable for my invention, have not given the fabrics to which they are applied the flameproof characteristics I obtain according to my invention. Compara-

tive laundering and accelerated weathering tests which have been made on woven 100% cotton fabrics and woven cellulosic fiber-asbestos fabrics according to my invention, demonstrate that, when such fabrics are both impregnated in an identical manner with flame-retardants and a thermoplastic waterproofing resin in accordance with the present invention, the cellulosic fiber-reinforced asbestos fabric of my invention is durably flameproofed, while the 100% cotton fabric is not. Apparently the flame-retardant materials and resin adhere much more strongly to the asbestos fiber yarns than to the cotton yarns. The asbestos fabric is capable of retaining the flameproof composition in sufficient quantities and in a condition not affected by washing or dry cleaning, while the 100% cotton fabric loses all flameproofing characteristics upon washing or dry cleaning.

Since there is such adhesion to the asbestos yarns, it has been found possible to produce durably flameproof fabrics by subjecting only the asbestos yarns to treatment with the flameproofing composition prior to weaving a fabric using such treated asbestos yarns and untreated 100% cellulosic fiber yarns. The resin on the thus treated asbestos yarn may be dried and fused either before weaving or after weaving. Treating the yarn before weaving insures complete contact of the retardants and resin with the fiber; whereas in treating the woven fabric there is not a certainty of adherence of the flame-retardant uniformly to all surfaces of the yarns embodied in the fabric. Nevertheless, it has been found that in general the most practical method of treatment is that comprising coating the woven fabric, which results in the durably flameproofed fabric.

The durability of the flameproofing composition is obviously due to the specific base fabric of cellulose fiber-reinforced asbestos which I utilize. Comparable laundering and accelerated weathering tests conducted simultaneously on 100% woven cotton and on cotton-asbestos fabrics containing 55–65% asbestos, after treating both fabrics simultaneously with an identical flameproofing composition containing diammonium phosphates and a thermoplastic vinyl chloride resin, showed that the treated 100% cotton fabric usually did not withstand a single washing and withstood no more than three standard laundering tests before loss of non-flammable characteristics; whereas the similarly treated asbestos-cotton fabric withstood more than fifteen such launderings while still retaining adequate flameproof properties to meet the A. S. T. M. and New York city tests. Similarly, the all cotton fabric lost flameproof properties originally imparted thereto, after cyclic accelerated weathering tests including 198 hours of arc light and 30 hours of water spray; whereas the asbestos-cotton fabric of the present invention was sufficiently flameproof to pass the tests after accelerated weathering for more than 378 hours of light and 58 hours of water spray. It is also of particular note that a cotton-reinforced asbestos fabric which has picked up in the flameproofing procedure a certain amount of solids remains durably flameproofed; whereas a 100% cotton fabric which is coated so as to contain a substantially greater amount of flameproofing solids loses the flameproofing characteristic upon washing or dry cleaning.

The all cotton and cotton-asbestos fabrics subjected to the above tests were closely woven fabrics containing 30's/2 and 12's/4 cotton warp and/or filling yarns, and 1216's/1 asbestos yarns. The number of warp yarns to the inch ranged from 24 to 32, and the weft or fill yarns averaged 26 to 27 per inch. The tested asbestos-cotton fabrics contained by weight 33–42% cotton and 58–67% asbestos. During the treatment with aqueous suspensions of flame-retardants and waterproofing resin, the fabrics picked up and retained on an average from 13 to 17% dry weight of inorganic flame-retardants and thermoplastic resin solids.

The laundering treatment involved immersion for thirty minutes in either plain water, or in water containing 0.5% laundering soap, at a temperature of 120–130° F., followed by rinsing and drying. The thus laundered sample was then subjected to a standard flameproof test, and the launderings were repeated until the sample failed to pass the flameproof test, or until the sample had been subjected to fifteen successive launderings and flameproof tests. In all laundering tests on 100% cotton fabric, any flameproof properties originally imparted to the fabric were lost before the fourth laundering treatment. All fabrics comprising cellulosic fiber-reinforced asbestos, even those containing asbestos filling yarn, together with 100% cotton warp fibers, which had a total asbestos content of at least 30% by weight, passed all flameproof tests, even after fifteen launderings. It was further demonstrated that it was the presence of the treated asbestos in the asbestos-cotton fabrics which extended the flameproof life of the fabrics. This fact was proved by simply withdrawing some of the flameproofed asbestos filling yarn from treated samples of the asbestos-cotton fabrics after the third laundering test, and observing that the remaining cotton warp yarns had lost any originally imparted flameproof characteristics. Regardless of how much flame-retardant material and thermoplastic resin was present in the cellulosic fiber content of the fabrics, it was the presence of treated asbestos in the cellulosic fiber-reinforced asbestos fabrics in an amount at least 30% by weight, as either warp or filling yarn, which imparted thereto permanent flameproof characteristics. It has also been demonstrated by test that in asbestos-cotton fabrics which have not been chemically treated in accordance with the present invention, and particularly such fabrics as carry inflammable vat dyes, the total asbestos content must be substantially greater than 80% by weight in order to impart any flameproof properties to the fabric.

It might appear that the durability of the flameproofing characteristic of my cellulosic fiber-reinforced asbestos fabrics is due only to the fact that, during each washing of both an all cotton fabric and, for example, the cotton-asbestos fabric, an equal amount of flameproofing composition is removed, but the cotton-reinforced asbestos fabric only needs an amount substantially less than that required by the 100% cotton fabric due to the inherent non-flammability of asbestos fiber. This, however, is not the case. As heretofore shown, the cotton fabric loses its flameproofing characteristics after washing. A cotton-reinforced asbestos fabric of 44–46% asbestos was treated with a flameproofing composition as herein set forth. A total of 16.8% by weight of solids was present on the fabric after curing. These solids included urea not destroyed during the curing procedure. The fabric was then repeatedly washed and weighed after each washing. It was found that after the first washing a total of 8.4% solids was present in the fabric, the loss being primarily due to the removal of the urea present. The fabric was weighed after all subsequent washings, and the deposited solid content remained at 8.4%. These facts are considered to clearly demonstrate that the above-set-forth theory with regard to an increment loss of flameproofing composition is not true, and indicates a definite cooperation between the cellulosic fiber-reinforced asbestos fabric and my flameproofing composition which renders the fabric flameproof with a durability not heretofore attained.

As previously indicated, the present flameproof fabrics embody at least about 25% by weight of cotton fibers in the form of all cotton warp or weft yarns. A fabric with all cotton warp yarns to the number of about 30 to the inch is preferred. Since the asbestos fibers which make up the asbestos yarns have an average staple length which does not exceed about ¾ inch, there is some advantage in incorporating cotton fibers in small amount even in the asbestos yarns, to improve strength. However, suitable fill or weft yarns may comprise 100% asbestos fibers, and the preferred fabrics usually embody asbestos yarns which

are somewhat coarser and less numerous per inch as compared to the all cotton warp yarns.

It will be understood that the details given are for the purpose of illustration, not restriction, and that variations within the spirit of the invention are intended to be included in the scope of the appended claims.

What I claim is:

1. The method of manufacturing an evenly dyed, lightweight, flexible, flameproof fabric which retains its flameproof characteristics after laundering and cleaning, which comprises forming a cellulosic fiber-reinforced asbestos fabric having an asbestos content of approximately 30–73% by weight by conventional weaving methods, imparting durable flameproof properties to said fabric by substantially uniformly coating with an inorganic flameproofing composition comprising antimony oxide and with a water insoluble solid thermoplastic resin selected from the group consisting of polyvinyl chloride, polyvinyl chloride-acetate copolymers, chlorinated rubber, and neoprene, said flameproofing composition and said resin being proportioned in amounts sufficient to cooperate at flame temperatures to effect flameproofing of said fabric, in an amount sufficient to effect a final coating solids content of at least approximately 7% by weight, and an inorganic compound content of at least approximately 4½% by weight of the fabric, heating to fuse and cure said resin, and imparting decorative fast color to said yarns by dyeing them with a vat dyeing procedure wherein the fibers are treated with the vat dye in the alkaline leuco state and then the dye reoxidized.

2. The method of manufacturing an evenly dyed, lightweight, flexible, flameproof fabric which retains its flameproof characteristics after laundering and cleaning, which comprises forming a fabric with conventional weaving methods employing all-cellulosic fiber yarns and asbestos yarns containing sufficient asbestos to impart to the woven fabric an asbestos content of approximately 30–73% by weight, imparting durable flameproof properties to said fabric by substantially uniformly coating with an inorganic flameproofing composition comprising antimony oxide, and with a water insoluble solid thermoplastic resin selected from the group consisting of polyvinyl chloride, polyvinyl chloride-acetate copolymers, chlorinated rubber, and neoprene, said flameproofing composition and said resin being proportioned in amounts sufficient to cooperate at flame temperatures to effect flameproofing of said fabric, in an amount sufficient to effect a final coating solids content of at least approximately 7% by weight, and an inorganic compound content of at least approximately 4½% by weight of the fabric, heating to fuse and cure said resin, and imparting decorative fast color to said yarns by dyeing them with a vat dyeing procedure wherein the fibers are treated with the vat dye in the alkaline leuco state and then the dye reoxidized.

3. The method of manufacturing an evenly dyed, lightweight, flexible asbestos fabric which comprises forming a cellulosic fiber-reinforced asbestos fabric having an asbestos content of approximately 30–73% by weight by conventional weaving methods, substantially uniformly coating said fabric with a composition containing a water insoluble solid thermoplastic resin selected from the group consisting of polyvinyl chloride, polyvinyl chloride-acetate copolymers, chlorinated rubber, and neoprene, in an amount sufficient to effect a resin solids content in said coating of at least 2½% by weight, heating to fuse and cure said resin, and imparting decorative fixed color to said yarns by dyeing them with a vat dyeing procedure wherein the fibers are treated with the vat dye in the alkaline leuco state and then the dye reoxidized.

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