

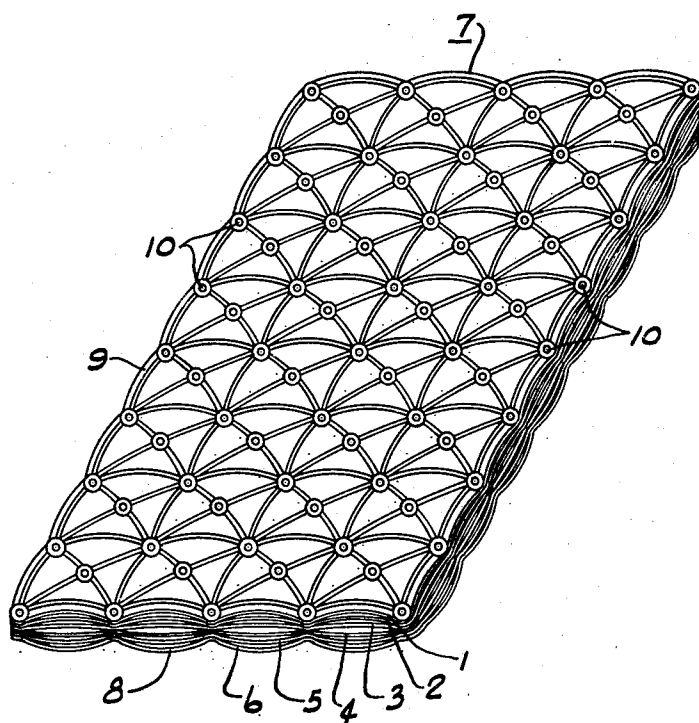
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TOBACCO SMOKE FILTERS

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**TOBACCO SMOKE FILTERS**

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**1 Claim. (Cl. 131—208)**

This invention relates generally to tobacco smoke filters and more particularly to the filter and the process of producing the same from fibrous material selected from synthetic and natural fibers chemically modified to provide a chemical filtration as well as mechanical filtration of influent tobacco smoke.

Most present cigarette filters are merely mechanical filters and have a limited filtering efficiency. Textile fibrous filters are generally provided in the form of a tow which offers a minimum exposed surface area due to the continuous filament nature of the tow. The fibers are all parallel although it may be provided with a slight wave. Other commercial filters are made of crepe paper supporting fibrous materials, the fibrous media of inorganic fibers and some papers of natural fibers such as cotton linters and wood pulp.

The inorganic fibers may be asbestos in finely divided form supplemented with cotton supported on rolled paper. These fibers do possess a more exposed surface than the tow as they have been carded and combed. However, the overall exposed surface of the fiber is of course limited by the paper employed. The paper is used to provide rigidity to the filter which resists the cutting action and prevents crushing of the filter during manufacture when incorporating the same into the cigarette from the rod form.

Filtering tobacco smoke and removing the harmful constituents must be accomplished in a fraction of a second. This is believed to be the chief important reason for having maximum exposed surface area even in mechanical filters. The amount of exposed surface area in the staple as compared with the aforementioned forms of filtering material is immeasurable. However, the draft resistance produced by the filter must not unduly impede the smoke stream. It is apparent that the commercial filter tip cigarette manufacturers do sacrifice filtering efficiency which is obvious from their use of tow in continuous filament form and in compact paper-fiber form in making filtered cigarettes.

The accompanying drawing shows for the purpose of exemplification without limiting this invention or the claim thereto certain practical embodiments illustrating the principles of this invention wherein a webbing made up of a plurality of slivers is shown tufted by a printed pattern of chemicals which improve the filtering action mechanically as well as chemically.

A filter comprising this invention is made essentially from a staple converted into slivers converged into a fibrous roving of the proper density and having selected fibers possessing small diameter filaments. Such a staple is practical for filtering efficiency, and also practical for the application of chemicals. This fibrous roving improves the mechanical efficiency of the filter and provides better physical properties.

The structure of the roving produces an adequate exposure of filament surface which results in high mechanical efficiency with practical draft resistance.

Roving may be adapted to produce filters in two dif-

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ferent methods both of which provide improved filters. The coiled roving made from slivers is drawn through a garniture. The size of the roving determines final proper density of the filter rod. The other mode of producing filters from roving is by the use of a multiple of small rovings, all of which are converged through a garniture to produce the filter rod of final proper density. In either instance it was found that the most practical filter was employed when using a roving of approximately one hundred grain density which has been found to be adequate for forming into filter rods. The garnituring of the roving into a continuous rope-like line together with a paper covering formed and cemented around the same produces what is known as a continuous filter rod. The rod is cut into lengths suitable for use in the cigarette machines. Sections are cut from each rod in the cigarette machine and a cigarette is formed on each end of each rod section after which the section is cut equal in halves to form two filter-tipped cigarettes.

In employing a multiple of small rovings, such as five rovings of twenty grains each, which, when drawn together through a garniture, produces a filter rod equivalent to one hundred grain density master roving.

The staple fibers making up the slivers 1, 2, 3, 4, 5 and 6 which form the webbing 7 have a certain percentage of cross fibers on the transverse dimension 8 of the webbing which complement inherent attraction to each other. The majority of the fibers in the slivers are aligned longitudinally as indicated at 9 of the roving, although there is a considerable percentage of cross fibers. These slivers 1 to 6 are superimposed upon each other forming a laminate which is known as web 7. Six or more plies of slivers form a web of six to seven and one half inches in width, and when garnitured produces a rope which when covered by paper forms a rod that provides proper compression hardness and proper density for a filter. The webbing is originally made in thirty-six inch widths and with six fibrous plies of slivers.

This webbing has applied thereto a solution of a polycarboxylic acid colloid named A-3 and finely divided resins XE-58 which respectively provide an anionic and cationic exchange system. The A-3 and XE-58 in a chemical manner augment the mechanical filtration system and provide simultaneous filtering action. A-3 is a polyacrylic acid hydrophilic colloid that is a clear, colorless, viscous stable solution. The polymer is a hydrophilic colloid of a high molecular weight.

XE-58 is a condensate product of bisphenol, formaldehyde and a polyethylene polyamine. It is bone dry and specifically treated to reduce to practically zero its content of any water soluble polymers, and is non-toxic. It is characterized by a free base form and thus will absorb acids without the necessity of further chemical treatment. It will absorb aliphatic acid and acid tars present in tobacco smoke, and it therefore, augments the physical phase of smoke filtration.

The addition of A-3 and XE-58 acts as a sizing on the webbing, a means of controlling compression resistance enabling it to be cut in strips of suitable width without losing its identity as webbing. The thirty-six inch width webbing of six-fibrous plies of slivers may be immersed in a solution of what is known as A-3 polycarboxylic acid colloid and then passed over a heated drying roll to produce the pretreated web. This webbing is then subjected to an applicator roll which applies a 10% water solution of the colloid A-3 as a vehicle in a mixture of 80 grams of this water solution to 20 grams of XE-58 a micronized powdered resin. The applicator roll for applying this solution to the webbing may do so in different designs such as herringbone lines that run slantwise on the webbing, dots, dashes, or other interrupted forms. Staggered dot pattern indicated at 10 on

the drawing produces a tufted effect on the webbing and provides a good orientation of baffles in the final structure. The applicator roll is an undulated or embossed or engraved roller which deposits in a specific pattern this resin mixture on the dried web thirty-six inches wide. The solution thus applied in a staggered dot pattern 10, quickly dries on the webbing which is then slit to proper widths and rolled to store until it is converted to a filter rod.

The proper size of webbing is then drawn through a garniture or eye by gathering the edges together and compressing the web into a continuous round filter line or rope. A paper is carried by a belt and fed under the line or rope as it passes out of the garniture. The paper is folded symmetrically around the line or rope by the belt and is passed through a second garniture or eye where its edges are cemented in place to form the filtering rods. As previously stated, the rod is cut into predetermined lengths and supplied to a cigarette machine which further cuts the filter lengths into sections and applies them intermediate the ends of cigarette lengths. The final cut is formed intermediate the filter section to produce two cigarettes.

The first solution originally applied to the webbing and the second solution applied on the webbing in the form of a pattern such as the dots 10, furnished additional stiffness to the finished filter rod so as to provide a definite hardness and resistance to compression that overcomes many cutting difficulties which results in better machine operating efficiency.

The A-3 polycarboxylic acid colloid or first solution which is mixed in a two and a half percent water solution, may be sprayed on the webbing or the webbing may be drawn through a bath of the same, after which the webbing is run through calender rolls and over drying drums heated to approximately 275° F. If this solution is sprayed on, it is applied only to one side of the webbing whereas if it is passed through a bath, the fibers become impregnated throughout.

A ten percent water solution of the colloid A-3 is used as a vehicle with XE-58 in proportions of eighty grams of ten percent water solution to twenty grams of XE-58 which is a micronized powdered resin. This mixture is stirred together homogeneously and, as previously stated, is applied by spray or by the use of an undulated roller which places the mixture of the predetermined pattern on the web.

XE-58 is known on the market as Amberlite and to all intents and purposes is the chemical equivalent of Amberlite IR-4B except that XE-58 is in the dry micronized form. IR-4B compositions are disclosed in U.S. Patents 2,356,151 and 2,402,384. This resin is capable of absorbing the tars and acid tars from cigarette smoke in a greater percentage than of any other known filter. The A-3 is a polycarboxylic acid colloid and is likewise purchased on open market. A filter made from these materials with a webbing of selected cotton will filter out over sixty percent of the nicotine in the influent smoke of the cigarette and will filter out over fifty percent of the tars contained in smoke.

The definite pattern of the second solution of A-3 and XE-58 on the webbing prior to its being run through a garniture effects a circuitous path for the travel of smoke through the filter. The treatment of the webbing by the A-3, and a combination of A-3 and XE-58 in a predetermined pattern, provides a very efficient and improved filter that will remove the tars and nicotine to a high percentage without unduly impeding the draft of the cigarette or without appreciably changing the smoking quality of the cigarette.

The colloid alone as applied to the webbing will remove over sixty percent of the alkaloids in cigarette smoke. The XE-58 resin is specific for tars and tar acids. The XE-58 ion exchange resin and the A-3 colloid each function as a chemical filter which is believed to be the

reason why the efficiency of this filter is so much higher than that of other filters known on the market. Other forms of filters such as papers treated with a mixture of XE-58 and A-3 colloid will remove a materially greater percentage of the nicotine, tars and tar acids from the cigarette smoke than the same structure without these chemicals. However, they will not have the other efficiency or attributes produced by the webbing in combination with these chemicals. The colloid A-3 alone is capable of removing over sixty percent of the alkaloids in the smoke of a cigarette and is quite beneficial when used alone in any of these type of filters.

Another process which was found to be successful is the formation of the webbing in three-ply and coating the same with A-3 on one side thereof after which it is folded and passed through rolls. The alkaloid adsorbent and tar and tar acid adsorbent chemical in the center of this webbing which when having the solution of A-3 and XE-58 applied in a pattern on one or both sides of the web and subsequently drawn through a garniture, keeps these chemical absorbing agents largely separated from one another and thereby employing the staples as a mechanical filter and the resinous area as a chemical filter.

The A-3 and A-3 plus the XE-58 solutions may be applied to the ordinary paper roll filters which would materially improve their adsorption quality but would not provide a filter as efficient as the filter made from webbing just described.

It will be noted that the construction of the filter from the webbing provides compression resistance of the filter with a minimum resistance to draft of the filter media. Channeling which presents a problem in commercial filter tips from tow is largely eliminated by the use of webbing. The selective predetermined pattern by which these chemicals are applied as dots, crosses, straight lines or herringbone or other patterns produce in themselves a devious travel of the influent smoke passing therethrough. This tortuous path has many baffles which with the cross fibers aid the quick adsorption by the chemicals of the alkaloids from the smoke which has been determined quantitatively. The web in itself functions as a supporting matrix as well as a mechanical filter. The addition of the chemicals to the webbing increases the tensile strength of the webbing, making it easier to handle and increases the operating efficiency in manufacture. The chemical treatment of the webbing offers less resistance to convergence through the garniture and formation into filter rods. By applying the chemical in a pattern form to the webbing, the same may be treated and stored and it does not necessarily have to be a continuous process in carrying on the manufacturing of the filter, which is novel as well as beneficial.

Different ingredients may be applied in combination or individually in different pattern forms as described herein as the case may warrant also their proportions may be determined as required. The draft may be controlled by the proper selection of different patterns or combination of patterns. In other words, the application of these chemical adsorbant materials produces a mechanical control of the circuitous path and the degree of deviation of the paths that the influent tobacco smoke must travel through the filter which is controlled and thereby increases the efficiency of the filter.

The webbing formed from staples of synthetic fibers or a combination of the synthetic and natural fibers may also be employed. The synthetic fibers may be polyamide synthetic fibers and cellulose acetate fine denier fiber staples, which after combining by the two and a half percent water solution of the A-3 colloid and after drying subsequently applying as previously disclosed in pattern form a 1 to 15 percent water solution of the A-3 in the amount of eighty percent to twenty percent of the XE-58 powder. In any event, when the A-3 is applied by spraying on one side of the webbing, the

amount of the solution applied can be controlled so that it need not have to pass through calender rolls to remove the excess as when the webbing is emerged from the bath. Webbing made of 100 percent natural fibers have been found satisfactory when made into filtering rods. We have also found that webbing made of 75 percent natural fibers and 25 percent synthetic fibers work satisfactorily in providing filter rods with this process. Webbing constructed of 50 percent natural fibers and 50 percent polyamide fibers together with a webbing of 100 percent polyamide fibers were found to provide the proper filtering characteristics when treated in accordance with the process of this disclosure.

Filters made from roving or webbing and treated with the A-3 alone or with the combined A-3 and XE-58 are good filters for tobacco pipes as well as for cigarettes. In each instance the fibers, where natural or synthetic, for roving or webbing may be treated when in sliver form. The webbing can be completely formed when treated. Both should be treated before passing through the garniture to form the rope or cord. The dots or broken lines may be applied to the slivers or the web by interrupted spray nozzles discharged against the material as it moves past a battery of nozzles. These designs may also be applied by pock marking a roller which can pick up the solution of A-3 or XE-58 and carry it to the material passed thereover. A second roll can be used as a backup roll. The design can be made on the rollery by constructing the roller from a series of discs, each having a plurality of notches in their perimeter. These discs may thus be set on a roll and clamped so that the notches of a consecutive series of discs are repeated every third or fourth disc and by slightly offsetting these discs the result is a constantly changing pattern of dots or broken lines on the material of the solution of A-3 or XE-58. When this material is made into a roving or into a webbing and the proper weight is garnitured, this pattern of dots or broken lines of dried solution A-3 or XE-58 provides a series of baffles that form a circuitous path for the smoke traveling through the filter. This alternate dot system of baffling is applicable to all forms of filtering material such as crepe paper and other forms.

By changing the amount of A-3 and XE-58 in this filter one can control their ability as acceptors for alkaloids and acid tars. If the adsorption of alkaloids and acid tars is too great, the taste of the smoker impairs his liking for the smoke. Thus one must control the acceptor A-3 to control the adsorption of alkaloids and control the XE-58 to control the adsorption of acid tars.

We claim:

10 A tobacco smoke filter comprising a garnitured, compressed webbing formed from a plurality of sliver laminations, each of the individual slivers having an impregnation throughout of a high molecular weight polycarboxylic acid hydrophilic colloid known as A-3, said webbing having printed thereon a pattern of resinous composition consisting of a mixture of both the polycarboxylic acid A-3 and a weak anion exchanger which is the condensate product of bisphenol, formaldehyde and a polyethylene polyamine known as XE-58, such that a zig-zag path for the influent smoke is provided in the garnitured filter.

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