

Dec. 1, 1959

M. O. SCHUR
SMOKING DEVICE

2,915,069

Filed July 13, 1954

4 Sheets-Sheet 1

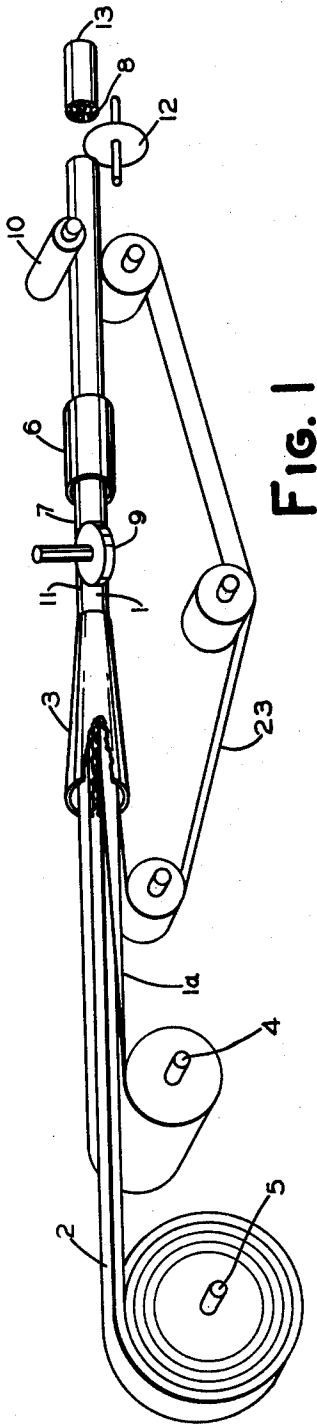
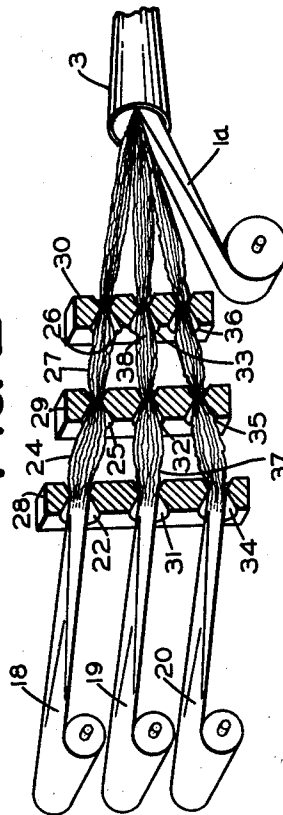


FIG. 1

FIG. 2



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FIG. 3

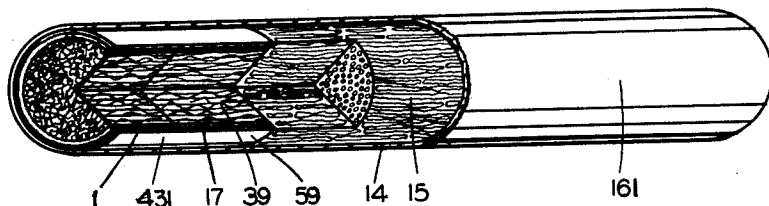


FIG. 4

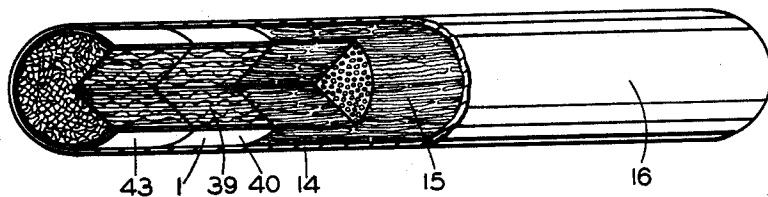


FIG. 5

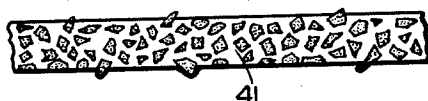
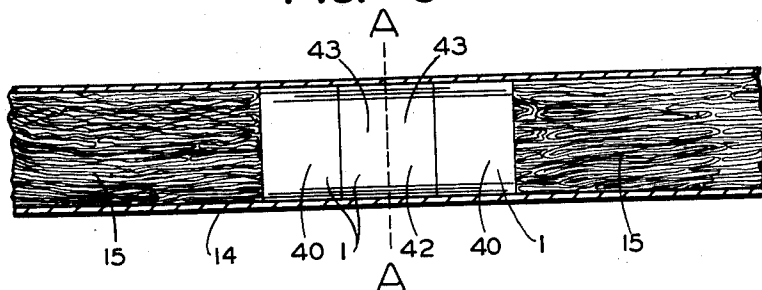


FIG. 6



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FIG. 7

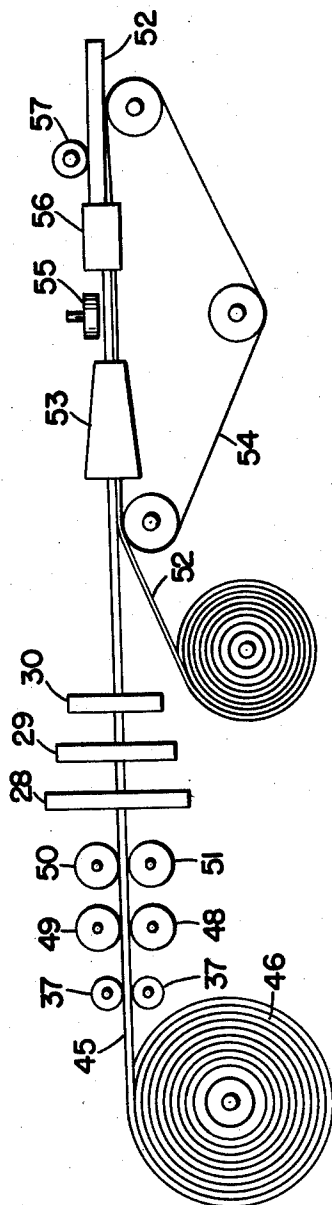
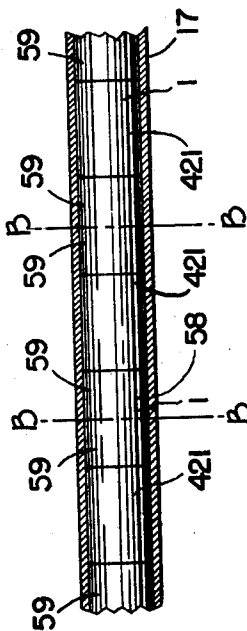


FIG. 8



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FIG. 9

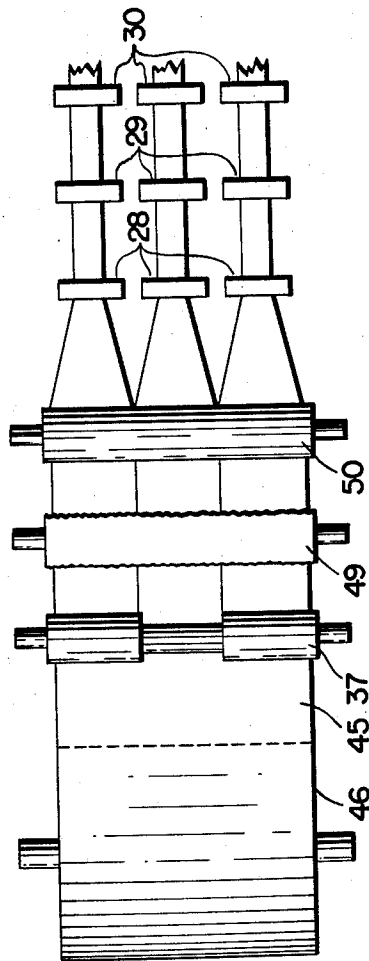
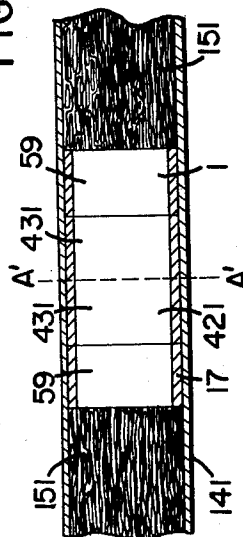


FIG. 10



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2,915,069

SMOKING DEVICE

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Application July 13, 1954, Serial No. 443,007

1 Claim. (Cl. 131-10)

This invention relates generally to cigarettes and similar tobacco smoking devices and more particularly to an improved filter therefor and to a novel method for preparing the same.

It has been the practice heretofore to provide smoking devices with a filter to remove filterable constituents from the tobacco smoke. Filters prepared from crepe paper in which the direction of creping runs parallel to the longitudinal axis of the filter and filters composed of alternate layers of paper and fluffy asbestos or cotton have been among the more successful filters heretofore available. These filters have been found to be relatively ineffective, however, in removing appreciable quantities of the undesirable constituents from tobacco smoke unless they are wound or otherwise compressed so tightly as to form a filter which impedes the flow of smoke therethrough to such an extent that the smoking properties of the device are greatly impaired. It also has been proposed to include charcoal and other adsorbent materials in the tobacco in such devices to improve the taste of the smoke but charcoal has not been utilized in filters for cigarettes and similar devices because of the difficulty of retaining it in an active condition in the filter. Such prior devices and methods of removing undesirables from the smoke and improving the taste thereof have had additional disadvantages including failure to remove some of the undesirable materials from the tobacco smoke.

It is an object of this invention to overcome such disadvantages and provide cigarettes and similar smoking devices with a filter which will effectively remove undesirable constituents from tobacco smoke without retarding the flow of smoke through the device to an objectionable extent. Another object of the invention is to provide a filter for tobacco smoking devices having improved filtration characteristics and also having an advantageous appearance. A further object of the invention is to provide an improved method for purifying and otherwise improving the qualities of tobacco smoke without detracting from the appearance of a cigarette. A still further object of the invention is to provide a cigarette having a filter adapted to remove undesirable gaseous as well as particulate constituents from tobacco smoke.

Other objects will become apparent from the following description with reference to the accompanying drawing in which

Figure 1 is a diagrammatic perspective view of one type of apparatus suitable for forming a filter illustrating one embodiment of this invention;

Figure 2 is a diagrammatic view of apparatus suitable in forming another embodiment of the invention;

Figure 3 is a perspective view of a cigarette, partly in section, illustrating one embodiment of this invention;

Figure 4 is a perspective view, partially in section, of a cigarette illustrating another embodiment of this invention;

Figure 5 illustrates filter paper of a type utilized in accordance with this invention;

Figure 6 is a diagrammatic view illustrating a method

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of assembling tobacco and filters to form a rod of tobacco and the filters to be subsequently separated into cigarettes;

Figure 7 is a diagrammatic view illustrating apparatus suitable for forming still another embodiment of the invention;

Figure 8 illustrates diagrammatically a method of assembling segments of filter material to form a filter for smoking devices;

Figure 9 illustrates diagrammatically, in another view, a portion of the apparatus of Figure 7, and

Figure 10 is a diagrammatic view illustrating another method of assembling tobacco and filters to form a rod of tobacco and the filters to be subsequently separated into cigarettes.

In accordance with this invention the foregoing objects as well as others are accomplished, generally speaking, by providing smoking devices having a filter composed of segments of fibrous material, with at least one of the segments of the filter containing particles of activated charcoal. Ordinarily, for best appearance, the filter when attached to a cigarette will be composed of segments, one adjacent the tobacco having particles of activated charcoal exposed to the passageways therein, and another segment being substantially free from charcoal or other discoloration at the mouth end. The invention contemplates as a preferred embodiment a cigarette having a paper filter containing particles of activated charcoal in combination with absorbent paper filtering material.

For the purpose of this invention, in the one segment the activated charcoal must be retained in such a manner that it does not become deactivated. The utilization of glue or the like to secure the activated charcoal particles to paper is entirely unsatisfactory for the purpose since such materials tend to deactivate the charcoal and prevent its subsequent utility. Such an undesirable condition is avoided in accordance with this invention by utilizing paper in which the activated charcoal is included with the pulp before paper sheet formation. The resulting sheet has the particles of charcoal secured to the individual fibers intermeshed throughout the paper in such a way that the combined exposed surfaces provide improved filtering efficiency. This is of considerable advantage since, while other adsorbent materials such as silica gel and the like are effective as filtering media, they do not lend themselves to either this method of incorporation with the fibrous material or to methods involving the use of adhesives or the like because they become too easily deactivated in the processing. While the filter material of this invention may be utilized with any type of smoking device, it is particularly well suited as a filter for cigarettes.

Although activated charcoal is particularly advantageous as an adsorbent for acrolein, hydrocyanic acid and other gaseous compounds in tobacco smoke, filters properly formed from suitably processed absorbent paper not containing activated charcoal have utility in removing particulate material. This invention thus provides a filter having optimum filtering characteristics by combining in one filter unit a desirable segment having adsorbent characteristics with an effective adsorbent paper segment. Moreover, in accordance with this invention it is possible to combine a segment containing activated charcoal with one or more segments which contain other adsorbent materials or reactants which are particularly well suited for removing certain specific undesirable constituents from tobacco smoke. In some embodiments, it is advantageous to place at least one segment of absorbent material between the tobacco and the segment containing activated charcoal in order to remove some of the undesirable particulate constituents before the smoke reaches the activated charcoal segment. With such an arrange-

ment, the activated charcoal is not saturated with constituents which can be otherwise absorbed and maximum adsorbability of the charcoal segment is thus maintained.

It is preferred, for best results, that the granulation of the activated charcoal be such that substantially all the particles thereof will pass through a Tyler screen having about 100 meshes per lineal inch and substantially none of the particles will pass through a Tyler screen having about 300 meshes per lineal inch. The paper tends to shed particles coarser than 100 meshes while particles finer than 300 meshes are less effective and tend to impart disproportionately undesirable black color to the segment. For best results, the sheet paper should contain from about 2.5 to about 50 percent by weight activated charcoal with about 20 to about 25 percent being the optimum amount for most filters.

In the composite filter of this invention the component segments or plugs may, of course, be of varied length. For example, they may be of equal length or, for optimum effectiveness in the removal of undesirable materials from the smoke, the segment containing the activated charcoal may be in the neighborhood of about twice the length of the segments not containing activated charcoal.

The filter of this invention having two or more segments has the further advantage of making it possible to use combinations of various types of filters formed from fibrous material. The segment which contains the charcoal may be formed by any suitable method but it is preferred that it be formed in accordance with the invention disclosed in the application of Milton O. Schur and James C. Rickards, Serial Number 400,072, filed December 23, 1953 to form a filter. This segment may then be combined with at least one segment formed from filaments of silk, cellulose butyrate acetate or other suitable fibrous filtering material. In another embodiment, preferred because of its exceptionally good filtering characteristics, both or all segments making up the composite filter are formed in accordance with the method disclosed in application Serial Number 400,072. In still another embodiment, a segment formed in accordance with the process disclosed by Edwards in U.S. Patent 2,160,201 and containing activated charcoal incorporated in the paper as described herein may be combined with any other suitable filter segment free from activated charcoal. Although high alpha paper is preferred for the absorbent medium other suitable materials can be utilized. Plastic filaments such as cellulose acetate, for example, can be utilized to advantage for forming the charcoal-free segment of this invention. Of the various combinations of segments possible, however, it is preferred that at least one be formed in accordance with the process disclosed in the co-pending application referred to above in order to insure optimum filtering characteristics. In fact, best results are usually achieved if each of the segments is formed in accordance with that process.

No care need be taken to align the passageways through one segment with those of an adjacent segment. Indeed, another advantageous feature obtainable in accordance with this invention is that such passageways will not be aligned and the passageways through the filter will thus be even more tortuous if the filter is divided into distinct segments than if in one piece. Such a divided filter is advantageous for some purposes even if no segment containing activated charcoal is included therein.

For optimum filtering characteristics paper weighing from about 7 to 30 grams per square meter before creping or before any other form of mechanical work such as crumpling or embossing has been performed should be utilized for forming the filter segments containing activated charcoal. A weight of about 7 to about 25 grams per square meter before mechanical working should be utilized to form the other segments. Sheets

of greater weight can be utilized in the segment containing activated charcoal because such paper is softer and more pliant than paper of a comparable weight not containing activated charcoal. Greater pliancy and better filtering characteristics are obtained if only high grade pulps of the so-called high alpha pulps of alpha cellulose content of at least about 90% are utilized to prepare the paper containing the activated charcoal particles as well as for preparing the other segments of the filter.

In order to better clarify and further describe the invention the following are examples illustrating typical embodiments thereof:

About 25 parts activated charcoal within the granulation range of from about 100 to 300 mesh are added to about 75 parts by weight paper fiber furnish on a solids basis. The activated charcoal is intimately mixed with the solids in the furnish and the mixture is formed by conventional means into a sheet of paper weighing about 9 grams per square meter. The sheet during manufacture is creped by conventional means.

After the formation of this sheet containing the activated charcoal, 38 plies thereof are piled one on the other to form a ribbon having 38 layers of paper, each about one-half inch wide.

Referring to Figure 1, a sheet 1(a) of conventional cigarette wrapper paper or other paper suitable for a filter wrapper is pulled from roll 4 by any suitable means such as by an endless belt 23 through the forming cone 3 of a conventional cigarette making machine. Before sheet 1(a) enters the forming cone 3, the one-half inch ribbon of 38 plies of paper 2 containing activated charcoal are pulled from roll 5 and are laid on sheet 1(a). As sheet 1(a) is pulled through the forming cone 3 it carries the layers of paper 2 through the forming cone 3 where they become crumpled and compressed together as sheet 1(a) is convolutedly wound thereabout to form wrapper 1. Edge 7 of sheet 1(a) remains substantially perpendicular during the early stages of this process. The width of wrapper 1 is about one and one-eighth inches and is sufficient to envelop completely the cylinder of one-half inch width paper strips. Before wrapper 1 emerges from the forming cone, the plurality of plies of paper have been gathered together and compressed therein leaving a maze of tortuous passageways 39 as illustrated to best advantage in Figures 3 and 4. A suitable gum adhesive is applied to edge 7 by applicator wheel 9 and edge 7 is folded to overlap edge 11 by means of the final forming cone 6. The overlapped edges 7 and 11 are tightly bound together as heated roller 10 passes thereover and removes water and any other liquids from the adhesive. Rotary cutter 12 severs the resulting labyrinth structure into rods such as 13. Rod 13 may be cut later to the desired length for use in making the filter. The density of the segments is about 0.1 to about 0.3 gram per cubic centimeter. The paper utilized is illustrated in Figure 5, the spots 41 indicating particles of activated charcoal.

A second segment 42 is formed in accordance with the process described in the foregoing with the exception that 38 plies of paper substantially free from activated charcoal is substituted for the paper 2 shown in Figure 1. The segment 42 is twice the length that intended to be used in the cigarette. Segment 42 is then assembled with two segments 40 previously cut from rod 13, one on each end thereof and the three segments are fed into a cigarette making machine where they are placed in a cigarette wrapper containing tobacco 15 in the position illustrated in Figure 6. The resulting continuous rod of alternate areas of tobacco 15 and filters composed of segments 42 and 40 positioned as shown in Figure 6 is then cut into lengths suitable for cigarettes by severing the wrapper 14 and segment designated as a whole by numeral 42 along the line A-A, Figure 6, to form two segments 43. The resulting cigarette 16, illustrated in Figure 4, has two segments 40 and 43 of sub-

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stantially equal length and tobacco 15 enclosed within wrapper 14. If it is desired to provide the cigarette with a filter in which either segment 43 or segment 40 is less than one-half of the length of the filter, the length is of course predetermined as it is formed, as illustrated in Figure 6.

A particularly advantageous method for crumpling the paper used in making the segments of the filter provided by this invention is illustrated in Figure 2. In accordance with this method, the paper is crumpled by passing through a series of orifices prior to its formation into segments by cone 3. In the particular embodiment shown, a web of paper 18 is pulled through a series of orifices 22, 25 and 26. The diameter of orifice 26 is less than that of orifice 25 while the diameter of 25 is less than the diameter of orifice 22. Simultaneously, web 19 is pulled through a similar set of orifices 31, 32 and 33 and web 20 is likewise pulled through orifices 34, 35 and 36. As shown in the drawing the orifices are formed in plates 28, 29 and 30 of a suitable plastic material. The plates are spaced apart sufficiently to permit each of the webs to expand as shown, at 24, 27, 37 and 38. The crumpled webs 18, 19 and 20 are wound in the web 1(a) to form a rod 13 such as shown in Figure 1. Such precrumpling is particularly desirable if the paper used for forming the filtering medium weighs more than about 16 grams per square meter.

In still another embodiment of this invention, the paper is embossed prior to crumpling and a particularly advantageous embodiment in which the paper is embossed and precrumpled is illustrated in Figures 7 and 9. In the embodiment illustrated, paper web 45 is fed from a roll 46 to a gang of rotary slitters 37 where it is cut into a plurality of strips of desired widths. These strips, which may or may not have been previously creped, may then be passed between embossing rolls. As illustrated in Figure 7, two pairs of embossing rolls are preferred. If in the first pair the positive roll 49 is the upper roll and the negative roll 48 is the lower roll then this arrangement is reversed in the second pair with the negative roll 50 the upper and the positive roll 51 the lower roll. The pairs of rolls are separated from each other in order that the paper may expand after being embossed by the first pair before it is embossed by the second pair. The positive and negative surfaces may be produced in accordance with any conventional means. For example, positive rolls 48 and 50 may be roughened by surfacing the roll with very coarse sandpaper. The surface of the negative rolls 49 and 51 should be of a soft material to permit the roughened surface of the positive rolls to follow the paper wrapper into it. A layer of sponge rubber or similar material is suitable for the surfaces of these rolls.

Ordinarily, in most embodiments, either the embossing rolls or the orificed plates of Figure 2 will provide sufficient mechanical working of the paper for the purposes of this invention, particularly if the paper has been previously creped. In one embodiment, however, each strip of paper cut by slitters 37 is passed through a series of orificed plates 28, 29 and 30 after having passed between the embossing rolls 48, 49, 50 and 51, as illustrated in Figures 7 and 9. This combination of embossing rolls and orificed plates may be desirable where the heavier absorbent materials are utilized. In Figure 9, paper web 45 is slit into only three webs of narrower dimension but in some embodiments, this web may be slit into a larger or smaller number of webs.

In the embodiment of Figures 7 and 9, the resulting crumpled webs are juxtaposed and fed with a web 52 of wrapper paper to a forming cone 53. As illustrated, web 52 is delivered from roll 45 by endless belt 54. Pasting wheel 55, final cone 56 and heater 57 are similar to those described in connection with the apparatus of Figure 1. The resulting rod of filter material is subse-

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quently cut to suitable lengths for the formation of filter segments.

One particularly desirable method for assembling filter tip segments prior to their combination with tobacco to form a cigarette is illustrated in Figure 8. In accordance with this method, the rods produced by one of the embodiments hereinbefore described are first cut into lengths twice that desired in the finished filter. A composite rod having a length equal to an integral multiple of the length of the final filter tip is then prepared by assembling these segments together. These rods, in one embodiment of this invention, are composed of alternate segments of two different types of filter material. For example, in Figure 8, segment 421 enclosed in wrapper 1 may contain particles of activated charcoal while segment 58 enclosed in wrapper 1 is formed from paper weighing about 20 grams per square meter but does not contain any adsorbent material. This plurality of segments is enclosed within a suitable wrapper 17 similar to that used for enclosing the tobacco in a cigarette.

The composite rod of Figure 8 may be cut into any desired length for feeding into a cigarette making and tipping machine such as is disclosed in U.S. Patent 2,156,600. The segments adjacent to the two ends of the rod would have a predetermined length suitable for the final filter on the individual cigarettes; the other segments would have a length twice that suitable in the final filter. In the cigarette making and tipping machine, the composite rods would be cut along lines B—B through segment 58 as illustrated in Figure 8 into composite rods of lesser length, each rod being composed of two segments 59 of the desired length, and one segment 421 twice as long as desired in the finished product.

The resulting composite rod of two segments 59 and one segment 421 may then be fed into the tipping zone of a cigarette making machine along with suitable charges of tobacco 151 and wrapper 141 and there assembled into the continuous rod, shown in Figure 10, of alternate tobacco sections 151 and filter sections composed of segments 59 and 421. Numeral 1 designates the wrapper about the filtering material of each segment. In this machine, the continuous rod of alternate sections of tobacco and filter is severed transversely along the line A'—A', through segment 421 to form a plurality of cigarettes 161 having a filter composed of segments 59 and 431 enclosed within wrapper 17, as shown in Figure 3. The rod of composite filter material of Figure 8 when cut to the proper length is also suitable for making filters for other smoking devices as well as for cigarettes.

If in forming the preferred segments of this invention, light weight paper of less than about 16 grams per square meter is utilized, good filtering characteristics are obtained if the only crumpling of the paper or other fibrous material is that done by the cone of a conventional cigarette forming machine while the paper is being placed within the wrapper. With the heavier weight papers of the invention and preferably even the lighter weight papers, however, the paper is crumpled by a process in addition to the one by which it is inserted in the wrapper. Any crumpling process which forms a multitude of irregularly extending and irregularly spaced crumples may be utilized to advantage, but best results are obtained if the paper is crumpled by a process wherein the crumples are formed in a plurality of steps with a time interval interspersed between each step for the paper to "spring back" or expand at least partially. A result similar to that desired is obtained by wadding or crushing a sheet of paper in the hand. In a preferred method for crumpling, the paper is drawn through a series of orifices or dies of graduated sizes, each orifice being smaller than the preceding one, as will be described in more detail, hereinafter. Paper crumpled in this way is much softer and is inherently more pliant than before such mechanical working, probably because the bond between fibers has been loosened or the fibers have been

partially pulled apart. A similar result is also obtained if the paper is heavily embossed before it is fed to the forming machine. Indeed, embossing is one of the preferred methods of preconditioning the paper for use in the manufacture of cigarette filters. In general, the greater the weight of the paper utilized, the more extensive must be the crumpling or other softening means for optimum results.

The filtering characteristics of a filter are further improved if substantially unfibrillated paper is utilized in forming the labyrinthal structure. As is well known in the paper making art, fibrillation is the first step in the conversion of pulp into paper. The more the cellulose fibers are fibrillated, that is, the longer they are subjected to the action of a beater, the greater the surface area of the fibrils and the tighter will be the interlock between the fibrils when they are formed into a sheet. Paper which has been formed from only moderately fibrillated or unfibrillated cellulose has an open structure which is substantially absorbent and the paper is relatively easily softened and crumpled. Paper containing activated charcoal may contain more highly fibrillated fibers than the paper utilized for forming the other segments of the filter because, as indicated hereinbefore, the charcoal tends to soften the sheet.

If crepe paper is utilized, best results are obtained if the direction of creping is transverse to the direction of flow of smoke through the filter. Preferably, the percentage crepe in the paper should be within the range of from about 8 percent to about 60 percent. In other words, a sheet about 10 inches long is reduced to a length in the range of from about 9.2 inches to about 4 inches when creped.

It has been found that the filter of the instant invention not only removes all of the undesired constituents removed by the filters heretofore available but has the added advantage of removing substantial quantities, often the greater part of the acrolein and hydrocyanic acid and other undesirable gaseous materials from the smoke. These filters are effective even though the resistance to the flow of smoke is no greater than that equivalent to the loss of head of about 5 centimeters of water when the smoke is passing through the filter at a rate of about 18 cubic centimeters per second. It has been found that a cigarette provided with one composite filter embodiment of this invention composed of one segment adjacent the tobacco which contains about 25 percent activated charcoal incorporated in the filtering medium in the fiber furnish and one segment containing no clinging particles of an absorbent material removed about 60 percent of the acrolein and about 30 percent of the tar from the tobacco smoke. The drag or loss was about 3.2 centimeters at a flow of about 18 cubic centimeters per minute. The charcoal containing segment was about 10 millimeters long and had a density of about 0.25 gram per cubic centimeter; the charcoal free segment of the filter was about 5 millimeters long and had a density of about 0.21 gram per cubic centimeter. Each of the filter tips in this embodiment was prepared substantially in accordance with the process of the embodiment described hereinbefore except that three strips of paper weighing about 20 grams per square meter were utilized. The three strips forming the segment having 25 percent activated charcoal incorporated therein were each about five inches wide and those forming the charcoal free segment were about seven inches wide. The filter of this invention not only removes particulates from the smoke, but unlike even the more effective filters heretofore available, removes irritating gaseous components. It offers no objectionable resistance to the flow of smoke therethrough.

The activated charcoal segments containing various types of activated charcoal which have been properly purified and which are of the desired characteristics, because of high adsorptive characteristics, particularly for substances in the gaseous form in the smoke, remove constituents from the smoke not removed by the heretofore known filters. The composite filter having adsorptive segments combined with absorptive segments removes a large proportion of the acrolein and hydrocyanic acid from the smoke and greatly reduces the concentration of other saturated and unsaturated aldehydes, ketones and saturated and unsaturated hydrocarbons, both aromatic and aliphatic as well as volatile acids.

Although various embodiments of this invention have been described in detail in the foregoing, such a description is only for the purpose of illustration and many modifications can be made by those skilled in the art without departing from the scope of the invention except as limited by the appended claim.

What is claimed is:

A filter for tobacco smoke comprising a wrapper, and enclosed within the wrapper a series of segments arranged in end to end abutting relationship, each of said segments consisting essentially of a plurality of fibrous layers of mechanically worked paper sheet originally weighing not more than about 30 grams per square meter substantially filling a length of said wrapper but having tortuous passageways extending generally longitudinally through the filter between the layers of paper, a substantial number of the passageways of one segment being out of alignment with passageways of the adjacent segment, the paper sheet having been mechanically worked until fibers thereof have been pulled apart, at least one of the segments in the series having particles of activated charcoal bound to the paper solely by intermeshing fibers of the paper, said charcoal having a granulation preponderantly within the range of from about 100 mesh to about 300 mesh, and at least one of the segments being free of charcoal particles.

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