

April 29, 1958

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2,832,351

METHOD OF TREATING TOBACCO SMOKE

Filed June 26, 1950

2 Sheets-Sheet 1

Fig. 1.

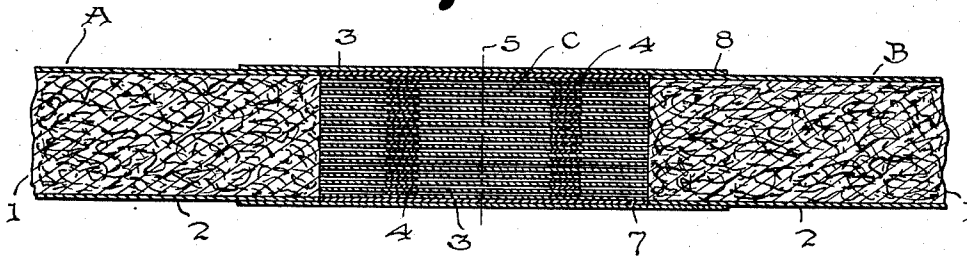
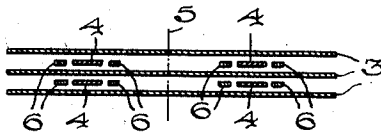


Fig. 2.



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2 Sheets-Sheet 2

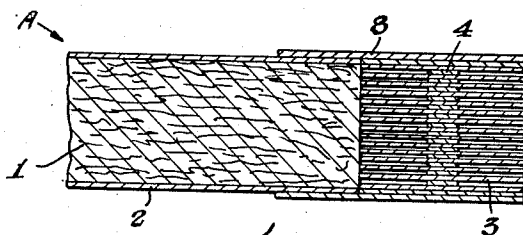


Fig. 3

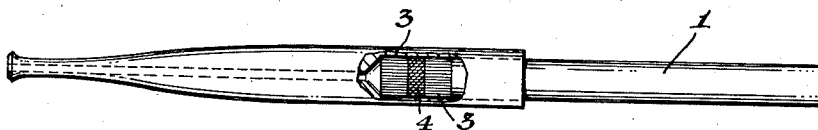


Fig. 4

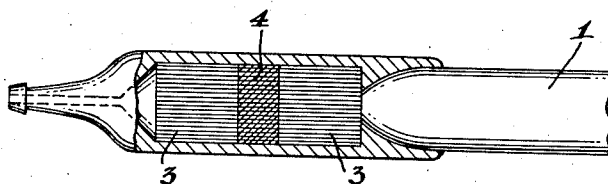


Fig. 5

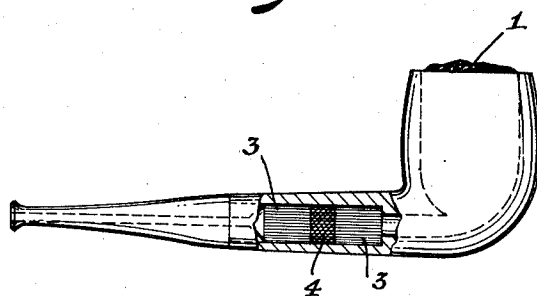


Fig. 6

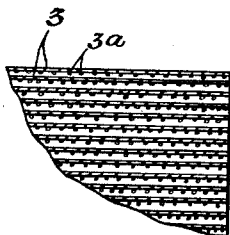


Fig. 7

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METHOD OF TREATING TOBACCO SMOKE

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9 Claims. (Cl. 131-10)

This invention relates to methods of testing tobacco smoke, more particularly to methods of removing undesirable oxidation products from burning tobacco, adjuvants and wrappers. This invention is a continuation-in-part of co-pending application Ser. No. 147,159 now matured as U. S. Patent No. 2,716,411, issued August 30, 1955 and application Ser. No. 147,160 filed March, 1, 1950 now abandoned.

In U. S. Patents 2,460,284 and 2,460,285, both issued on February 1, 1949 it was disclosed that when cured tobacco and paper wrapping of tobacco, respectively, are impregnated with solubilized chlorophyll or related porphyrin type compounds, the finished product in the process of smoking undergoes a more complete burning by reason of the catalytic oxidizing effect of the chlorophyll.

The mechanism of this marked activated oxidation for both tobacco and wrapper involves the evolution of nascent oxygen from that component of chlorophyll known as chlorophyll-*b* whereby such activated oxygen immediately attacks the acrid vapors carried in the smoke passing over the chlorophyll. When chlorophyll-*b* thereby loses oxygen it reverts to chlorophyll-*a* only again to become transformed into chlorophyll-*b* in the presence of air. The carotenes, as naturally occurring concomitants of chlorophyll, function directly to protect this chlorophyll against its own decomposition and thereby speed up this oxidative-reductive activity.

The several derivatives of porphyrins as a class that function definitely in the direction here indicated comprise the chlorophyllins or gently hydrolyzed chlorophylls, the magnesium-free chlorophylls or pheophytins-*a* and -*b*, as well as the hydrolyzed forms of the latter known as pheophorbides-*a* and -*b*. In general the highest oxidative-reductive potential is displayed by those porphyrins carrying a 5-membered carbocyclic ring at positions 6 and gamma (H. Fischer System of Nomenclature) and known specifically as phorbins.

In the normal burning of tobacco, which is chiefly cellulose, and in the burning of paper which is almost pure cellulose, there is always detectable a goodly portion of acrolein ($\text{CH}_2\text{:CH}\cdot\text{CHO}$) in the vapors issuing therefrom as well as other undesirable compounds such as carbon monoxide and the like.

In the patents above cited there is set forth the course of these oxidative processes when tobacco, as well as tobacco wrapper, is made to contain no more than approximately 3 percent of its weight of chlorophyll. The effect of this adjuvant is most striking, scarcely a trace of acrolein or any other highly volatile aldehyde is detectable in the smoke evolved from such a chlorophyllized cigarette; hence rasping or acrid effect of said smoke upon the lining membrane of the throat of the smoker is substantially eliminated.

Though the weight of cigarette paper to weight of tobacco content of cigarette is of the order of only 1 to 30, even this small portion of the burning cigarette imparts

a decided acrid taste to the smoke thereof, as well also as a stinging sensation and lachrymatory effect from the secondary smoke issuing directly into the air from a lighted cigarette. This effect obtains even when good oxidizing agents, as for example potassium nitrate, are incorporated in the wrapper. Chlorophyll serves as oxidant at terrestrial ambient temperatures and readily destroys the aldehydes and other oxidizable components drawn over its surface within tobacco or wrapper by the smoke, while it itself undergoes deoxidation; only again to take up oxygen from the accompanying air and again contribute said oxygen to destruction of readily oxidizable vapors that are brought in contact with the chlorophyll. This action terminates, of course, with too close approach of the fire zone which causes decomposition of the chlorophyll.

By reason of the greater ease with which the more volatile acrolein, and aldehydes and ketones of lower molecular weight, are oxidized in the presence of the catalyst chlorophyll or its derivatives, it is apparent that chlorophyllized cigarettes are definitely less irritating to the throat, lungs and nasal passages of the smoker.

On the other hand, it is to be noted that nicotine and its congeners in chlorophyllized cigarettes and cigars suffer little or no oxidation. This is due to the far greater tendency or preference to oxidation displayed by aldehydes of low molecular weight in consuming the total supply of activated oxygen available. In like fashion the quantity of toxic carbon monoxide is simultaneously reduced. As a result the desirable aroma and taste of the smoke remains generally unimpaired.

However, the incorporation of chlorophyll in cigarettes may involve two undesirable characteristics. The first, concerns the slight bitterness that is inherent in water-soluble chlorophyll when it comes in contact with the lips of the smoker. The second concerns the slight astringency to smoker's lips when oxidation of aldehydic vapors is incomplete and yields a trace of organic acids in place of undergoing complete combustion into water and carbon dioxide. The first objection is obviated by utilizing an insoluble chlorophyll as set forth in the above mentioned U. S. Patent No. 2,716,411, and application Ser. No. 147,160. The second objection disappears when the cigarette is smoked not too rapidly. However, to make doubly sure of no astringency the following procedure is now found highly acceptable.

The use of an insoluble form of an oxygenative porphyrin has earlier been considered highly desirable. A procedure for its incorporation within the body of the cigarette and wrapper has only of late been found practical. The procedure here primarily concerns a filter, preferably a roll of filter paper, which is then treated with chlorophyll dissolved in alcohol or other suitable solvent; such as is set forth in application Ser. No. 147,160.

It is now discovered that a decided improvement in the entire make-up of cigarettes may be secured by a specific allocation or placement of chlorophyll within the filter portion. Whereas, heretofore, there has always been too much tarry material collecting at the forward end of the filter, even to the point of covering the active chlorophyll, it is now discovered that a ribbon of chlorophyll at mid-portion of the filter, extending across the exposed surface of the filter transversely to longitudinal axis of the filter, is most effective as an oxidant against incoming vapors laden with aldehydes, and at the same time is far less likely to be covered with tarry material by reason of the latter's more ready condensation at the forward end of the filter free of chlorophyll.

In order to more clearly explain the invention there is shown in the accompanying drawings a preferred embodiment in which the benefits of the invention are achieved.

In the drawings Fig. 1 is a longitudinal section of a cigarette during the course of its manufacture. Fig. 2 is an enlarged detail view of the elements of the filter unit. Figure 3 shows a complete cigarette containing the filtering means of the present invention; Figures 4, 5 and 6 show the filter means as described herein in a cigarette holder, a cigar holder and a pipe, respectively; and Figure 7 shows a section of a modification of the present invention wherein the chlorophyll particles 3A are located on the surface of the filter means.

A major purpose of the invention is to make doubly sure of the removal of astringent acrylic compounds, unexpectedly set up in oxidation of toxic aldehydes coursing through the body of the cigarette tobacco. To this end it has been found that the introduction of a ribbon of basic material, as sodium carbonate or calcium carbonate or alkaline earth hydroxides both fore and aft of the chlorophyll ribbon totally eliminates all toxic acrid vapors, and all the more accentuates the function of the chlorophyll upon the vapors passing over it. Furthermore, the presence here of carotenes (the naturally occurring concomitants of chlorophyll) as stabilizers to said chlorophyll, renders this type of filter so exceedingly active that only the slightest amount of chlorophyll is called for in the tobacco mass within the cigarette proper.

Such a preferred type of cigarette is shown in the accompanying drawings. In producing the novel filter cigarettes of the present invention and consonant with current commercial practice a double length filter is associated with two aligned preformed cigarettes and after adhering or affixing this double filter to the ends of adjacent cigarettes the filter is cut or severed to produce two cigarettes each provided with its attached filter.

The method of fabricating the novel cigarettes and the resulting product will be more readily comprehended and appreciated from a consideration of the unit shown in the accompanying drawings. As there shown, during the course of manufacture a series of identical cigarettes are made up and placed in aligned relationship with a double length filter interposed therebetween. The filter is of special construction, as will be more fully described. After the two identical cigarette units have been aligned with the interposed filter a single wrap tip 8 of cork, regenerated cellulose or other suitable material is attached to the filter and adjacent ends of the cigarette units with any suitable adhesive and the filter is severed at the midpoint to thus produce two identical cigarettes with attached filters.

Considered more specifically and as shown in Fig. 1, the cigarette units A and B each comprising a tobacco filling 1 and a paper wrapping 2 are placed in aligned and spaced position in any suitable machine. Interposed between the two cigarette units and abutting the respectively adjacent ends is a novel filter unit designated generally at C.

This filter unit preferably is preformed and is of special construction. This construction should be of such a type as to permit the ready transpiration of smoke vapors therethrough with minimum clogging or impediment of the vapor passages by condensed tarry products. Preferably, this filter is produced by convoluting a number of strips 3 of a crepe-like filter paper to form a relatively tight cylindrical roll. Interposed between the alternate strip 3 of such paper are two narrower strips 4 of a tape of chlorophyll treated paper or other cellulosic material. As will be observed from an inspection of Fig. 2 the chlorophyll treated strips or bands 4 are located substantially midway between an end and the center line 5 of the filter. Thus when the filter is cut or severed on such center line the chlorophyllized zone of the filter, represented by the numerous convolutions of strip 4 occupies a position spaced from the tobacco fill 2 and from the exposed lip-contacting end of the filter.

As noted previously, it is also desirable to incorporate

nates or hydroxides in the filter unit for the purpose of neutralizing partially oxidized aldehydes, i. e., those of a basic material such as alkali or alkaline earth carbonized only to the corresponding acids. This, as noted, may be done by interposing between the filter sheets 3 and on each side of each chlorophyllized strip 4 a strip or band 6 of suitable woven or matted cellulosic material impregnated or dusted with a base material of the type mentioned. This form of the invention is shown in Fig. 2. The beneficial effects of such neutralizing adjuvant may similarly and more simply be achieved by incorporating such base material in or on the ribbons 4 either by dusting on such base material in powdered form or impregnating or spraying the ribbon 4 with a solution of the alkaline reagent and drying. Such impregnation may be done before or after application of chlorophyll to the ribbon 4.

Fig. 2 shows diagrammatically a modified form of the invention shown in Fig. 1 wherein members 6 are disposed on both sides of the member 4. The members 6 may be included in the same relative locations as shown in Fig. 2 in the form of the invention shown in Fig. 1.

The porphyrin compound employed in the filter through incorporation in the ribbon 4 may be of any desired type. In a preferred procedure a solubilized chlorophyll, i. e., either a water soluble chlorophyll such as chlorophyllin, pheophytins or phenophorbides are dissolved in water and this solution is employed as a saturant for the cellulosic ribbon 4. If desired water insoluble porphyrins may be dissolved in a suitable solvent such as alcohol and this alcoholic solution may be used as the saturant. Again insoluble chlorophyll in relatively pure form or preferably with its naturally accompanying carotenoids may be ground to any degree of fineness desired and may be dusted on the cotton or paper ribbon 4 either prior to convoluting ribbon 4 with filter strip 3 or during this convoluting or rolling operation. Obviously instead of using the separate ribbon 4 the powdered chlorophyll may be deposited directly on the strips 3 in a line or zone delineated generally by the ribbon 4. The powdered chlorophyll may be adhered to strip 4 or to a given zone of filter strip 3 by applying to the paper strips a light coating of a suitable adhesive such as a dextrin glue and dusting the powdered chlorophyll on the adhesive area.

So effective is this insertion of chlorophyllized ribbon comparatively removed from ends of the filter and definitely protected from smearing by tarry products, that it becomes almost unnecessary to apply more than a minute quantity of chlorophyll to the tobacco itself. The paper wrapper of the cigarette, however, can never be made to lose its acrid vapors save by the actual presence of an oxidant such as chlorophyll imbedded within its structure.

After the filter unit C with its incorporated, interleaved chlorophyll and alkaline zones has been rolled, it is encased with a holding strip 7. This may be passed around the rolled filter strip and the overlapping ends adhered to each other to form a complete double length filter unit. This, as noted, is inserted between the two spaced ends of the aligned cigarettes A and B and in abutting relationship to such cigarettes. Thereafter the tip 8 is wrapped around the filter and, as shown, around an end section of each cigarette. The tip 8 is glued to the cigarette wrapper 2 and its overlapping ends are glued to each other with any suitable adhesive. After such operation the conformed units are severed or cut at the line 5 to thereby produce two completely fabricated cigarettes containing a chlorophyllized filter.

In producing the cigarette the tobacco of the filling and the paper wrapping 2 preferably are treated with solubilized chlorophyll in accordance with prior Patents 2,460,284 and 2,460,285. However, the chlorophyllized filter of the present invention is so effective that the chlorophyll may be omitted from the tobacco or only a minute quantity of chlorophyll may be incorporated in

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the tobacco. The paper wrapping, however, preferably should contain a sufficient amount of chlorophyll to effectively oxidize the acrolein derived therefrom so as to eliminate the lachrymatory effect arising from secondary smoke on which the chlorophyllized filter does not function.

It will be observed that the preferred ultimate cigarette produced as described herein comprises a cigarette, the tobacco fill and paper wrap of which contain a specific and highly effective oxidant, namely, a porphyrin such as solubilized chlorophyll. In addition the cigarette embodies a filter through which the primary smoke is constrained to traverse. This filter essentially comprises two zones. The primary zone, which extends from the end of the cigarette proper up to the zone or section which contains the chlorophyllized units 4 (or the equivalent chlorophyll deposited directly on the strip 3), comprises in a sense a mechanical filtration and condensation zone. In this area of the filter the condensable tars entrained in the smoke are condensed and deposited on the filter area immediately adjacent the actual end of the cigarette. This section thus serves as a primary condensation and tar separation zone. The substantially tar-free vapors then traverse longitudinally through the second zone of the filter and during such passage intimately contact the chlorophyll in the chlorophyllized zone, as represented by the tapes or chlorophyll deposit 4. The preliminary removal of the tarry matter in the forward end of the filter thus minimizes or prevents the encasement of the chlorophyll with condensed viscous tarry products and insures the presence of active exposed chlorophyll oxidation surfaces to the smoke prior to inhalation in the mouth. This preliminary tar condensation zone afforded by the section of the filter adjacent the abutting end of the cigarette thus insures a greater effectiveness of the chlorophyll for its oxidative function and commensurately reduces the amount of chlorophyll required to insure the desired complete oxidation of the oxidizable constituents of the cigarette vapors and smoke. Inasmuch as the chlorophyll or equivalent oxidative material is placed intermediate the ends of the filter and removed or displaced from the mouth contacting end, there is no danger of the tongue or lips of the smoker coming in contact with chlorophyll.

As noted previously, the use of a basic material as by way of incorporation in paper tapes 6 or 4 is directly correlated with the function of the chlorophyll. This basic material serves to neutralize the oxidized aldehydes, i. e., those oxidized to the corresponding acids, to thus more completely eliminate acrid and irritating components from the tobacco smoke.

It will be apparent that while a specific filter construction which achieves the advantages of the invention has been described, this may be modified in many particulars within the scope of the invention. Thus the oxidative zone as represented by the chlorophyllized cellulosic strip or ribbon may comprise two such ribbons or strips within each filter section, such strips being spaced from each other and from the ends of the filter. In such a filter there is thus established, so to speak, a primary and secondary oxidation zone prior to each of which is a filtering section or zone which is effective for the removal of tarry products. Similarly, while several methods of and means of establishing the oxidative zone within the filter have been described, these are given as illustrative only and as comprehending any method of establishing a quantity of an oxidative porphyrin in a filter at a point spaced from the tobacco such that tarry products are preliminarily removed from the smoke and the tar-denuded smoke is then caused to traverse a section containing the active oxidant.

This concept of associating with a cigarette or cigar a filter zone through which the smoke is caused to pass in contact with the oxygenative porphyrins may also be

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effectuated by employing a cigarette or cigar holder having a suitable cavity or chamber in which a replaceable or disposable chlorophyllized filter carrying basic protectants, as well as certain stabilizers as described above, is inserted. During smoking of the cigar or cigarette the smoke traversing the filter contacts the oxygenative chlorophyll to thus effect the destruction of the acrid components of the smoke.

While several modifications of the invention have been described, it will be understood that these are given to illustrate the underlying principles involved in which chemical conversion of undesirable components of the smoke are effectually oxidized and absorbed within a filter zone. In such filter zone, as has been explained, concomitant removal of undesirable tarry material is also effected.

I claim:

1. As an article of manufacture, a cigarette having a porous smoke filter associated with one end thereof, in which filter is incorporated a quantity of an oxidative porphyrin in a zone of said filter spaced from the two ends thereof.

2. As an article of manufacture, a cigarette having a porous smoke filter associated with one end thereof, in which filter is incorporated a cellulosic ribbon containing an oxidative porphyrin disposed at an equal distance from the two ends of the filter, and a basic material incorporated in the filter adjacent such ribbon.

3. As an article of manufacture, a cigarette, having a porous smoke filter associated with one end thereof, said filter including a ribbon of absorptive material impregnated with chlorophyll extending transversely to the longitudinal axis of the cigarette, such ribbon being spaced an appreciable distance from the two ends of the filter.

4. As an article of manufacture, a cigarette having a porous cellulosic filter connected with one end thereof, said filter having incorporated therein a ribbon of absorptive material impregnated with chlorophyll, said ribbon extending transversely of the longitudinal axis of the cigarette, and a ribbon of cellulosic material supporting a basic material, said last mentioned ribbon being disposed on each side of said first mentioned ribbon.

5. A filter for insertion in pipes and cigar and cigarette holders comprising a plug of porous filter material carrying at its mid-zone a ribbon of an oxidative porphyrin, and a ribbon of cellulosic material supporting a basic substance being disposed on each side of said first mentioned ribbon, and said ribbons being spaced from the ends of the filter.

6. A filter for insertion in pipes and cigar and cigarette holders comprising a plug of porous filter material carrying at its mid-way point a ribbon of oxidative chlorophyll substance, and a ribbon of basic substance bordering each side of said first mentioned ribbon, said ribbons being spaced equidistant from both ends of the filter.

7. A filter unit for insertion in pipes and cigar and cigarette holders comprising a mass of a porous cellulosic material having incorporated therein an oxidative chlorophyll substance and a basic material, said chlorophyll substance and basic material being disposed in the mid-portion of said filter.

8. As an article of manufacture a cigarette filter comprising a tube made up of a convoluted sheet of a filter-type paper and a quantity of chlorophyll interleaved in such convolutions and contained only within the mid-portion of the tube.

9. The method of treating porous cellulosic cigarette filters comprising establishing in the mid-zone of the filter and spaced respectively from the tobacco contacting and mouth contacting ends of the filter a quantity of an oxidative porphyrin.

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