April 14, 1964 E. M. SCHAAF, JR 3,128,680

METHOD OF FORMING CIGARETTE FILTER

Filed March 15, 1960

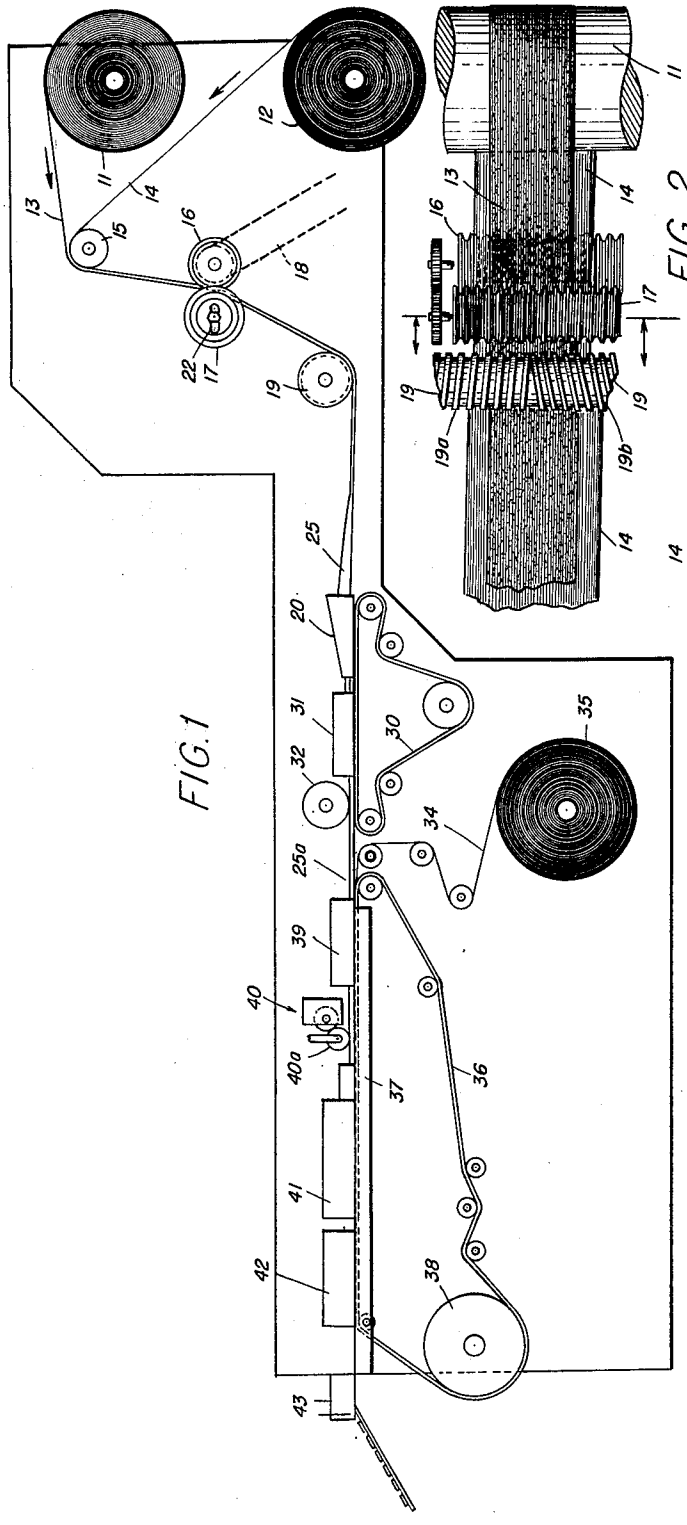

FIG. 1

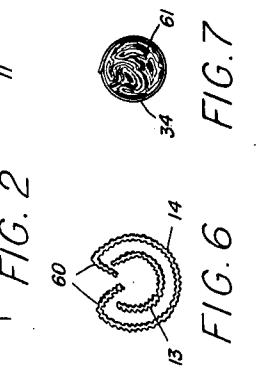

FIG. 2

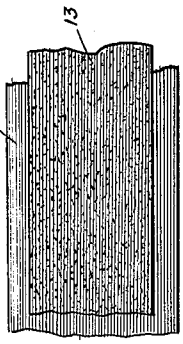

FIG. 3

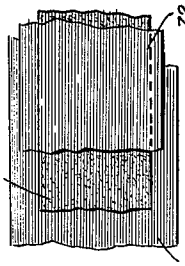

FIG. 4

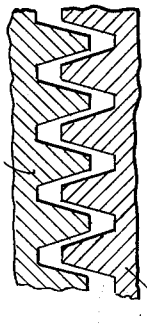

FIG. 5

FIG. 6

FIG. 7

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METHOD OF FORMING CIGARETTE FILTER

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The invention concerns filter plugs for cigarettes or similar smoking products including the method of forming the continuous filter rod which is ultimately cut into short sections comprising the plugs incorporated in the cigarettes or like articles. It has heretofore been proposed to incorporate in filters various solid materials in powdered or particulate form. Powdered or granulated carbon has been found to be particularly useful for the purpose. A difficulty has been encountered, however, in satisfactorily embodying the powder. An obvious manner to incorporate the powder is to secure it to the surface of a fibrous sheet material by means of an adhesive. This produces, however, the problem of finding an adhesive which is free of harmful or distasteful odors or flavors and also does not deactivate the absorbing or adsorbing property of the material such as carbon.

In an effort to avoid the above difficulties and others, it has been proposed to mix the solid material in a paper pulp of fibrous cellulose material prior to formation into the finished sheet material. To retain the carbon in a condition accessible to the smoking gases, however, necessitates the sheet material be of an open mesh uncalendered character and consequently of low strength and also the solid powdered material is easily shaken loose as the paper is subsequently crumpled and worked into a filter rod form. The lack of adequate strength for working, and the tendency of the powder to loosen and fall out, are manifested particularly when the solid material such as carbon is present in a relatively large amount or proportion corresponding to that which would normally be desired.

The present invention is directed to providing a filter embodying the selected powdered material, and other chemical additives when desired, and which avoids the above described difficulties. Important features of the method and product comprise arranging in plied relation and feeding together one or more strips of the sheet material embodying the powdered filter substance and one or more strips of a soft fibrous absorbent sheet material having greater strength. The plied sheets are passed through an embossing means such as complemental corrugating rolls which cause the sheets of different character to be interleaved. The plied embossed strip is then passed through a folding and shaping horn which crumples the plied strip into a longitudinally pleated round rod and an outer wrapping strip is then applied resulting in a continuous cylindrical rod in which the sheet material of the two different types is interleaved with interdigitated surface areas of the two strips and the solid material, such as carbon particles where that is the selected material, project into and occupy to large extent the minute spaces or longitudinal passages through which the smoke of a cigarette is caused to travel. The absorbent more closely woven plain sheet material furnishes the needed strength for the physical manipulations including the feeding of the strips and serves as a carrier for the weaker impregnated sheet material. The stronger sheet material serves also to enfold and enclose the impregnated sheet material and prevent the loss of solid particles therefrom. It performs this function not only in the forming of the filter rod but also aids to a considerable extent in preventing the shaking loose of the powder in the finished filter plug.

The invention accordingly comprises the several steps in the formation of the filter rod and the relation of the

steps to each other and the selection and manipulations of the materials, and the resulting continuous filter rod and correspondingly the ultimate filter plugs as embodied in smoking articles all as hereinafter described. In connection therewith reference should be had to the attached drawings in which:

FIG. 1 is a general assembly view in elevation and largely diagrammatic showing the feeding of the sheet materials and the physical manipulation thereof into a continuous filter rod adapted to be severed into appropriate desired lengths;

FIG. 2 is a fragmentary top plan view of the right hand portion of FIG. 1;

FIG. 3 is a fragmentary section in plan of the plied layers of materials;

FIG. 4 is a view similar to FIG. 3 but showing the embodiment of a different arrangement of sheet material;

FIG. 5 is a fragmentary view showing the relation of the teeth of the corrugating rolls;

FIG. 6 is a cross-section of the continuous strip material in an early stage of its being laterally crumpled and pleated into a cylindrical rod form; and

FIG. 7 is a cross-section representative of a filter rod made by the method of the present invention.

The method of forming the filter rod may be performed with various types of apparatus and the manipulations may vary to some extent. Accordingly the apparatus shown in FIG. 1 is largely diagrammatic. It comprises an assemblage of parts mounted on a suitable frame indicated at 10. It includes a source of supply of the sheet material such as indicated by the rolls 11 and 12. The number of plies of each material may vary dependent upon the circumstances. In the present illustration the filter rod is made from one ply each of the two types of material. The first type indicated as roll 11 comprises a sheet material impregnated with a powdered or granulated solid smoke filtering material to be described more fully hereinafter. The other sheet material carried on roll 12 comprises a strip of fibrous material such as crepe paper or any one in general of the various types of soft uncalendered paper composed of cellulose fibers heretofore employed in making crumpled paper filters for cigarettes. The strips 13 and 14 advance from rolls 11 and 12 respectively in superposed plied relation over idler roll 15 being advanced by a pair of complemental rolls 16 and 17. The rolls 16 and 17 are geared together and one of them is driven as indicated by the belt or chain 18. The plied strips are also advanced by the rod forming apparatus in timed relation with the drive of the rolls 16 and 17 as will shortly be described. The plied strip continues under the idler roll 19 and into and through the funnel or horn 20 of the rod forming apparatus.

As previously indicated the number of plies of each of the materials may vary, and likewise the respective sizes, within the ultimate requirement that the total quantity be such as to be appropriate for a cigarette filter plug, taking into consideration further the fact that the lateral compaction or compression of the sheet material into pleated form must result in a filter rod which has an acceptable firmness and resistance to draw. In FIG. 3 the plain sheet of absorbent material 14 is shown as slightly wider than the solid particle impregnated sheet 13 superposed thereover.

The material selected for the impregnation of the strip 13 may be of different character depending principally on the desired results and may comprise for example various known substances such as a silica, alumina, diatomaceous earth, charcoal, various oxides such as cobalt oxide, iron oxides, or suitable anion or cation exchange materials. Powdered carbon or charcoal, however, is particularly useful for the purpose having exceptionally good absorbing and adsorbing properties for various gaseous and solid

substances contained in cigarette smoke. The base sheet material designed to serve as a carrier for the solid material preferably comprises an open mesh sheet of fibrous material which may be in general a paper pulp. The sheet thickness may vary dependent upon the circumstances, a practical range being for example about .005 to .015 inch. The amount of carbon or other solid material embodied therein may vary within a considerable range depending upon circumstances and the particular material. The overall strength of the sheet material of course varies with its porosity and the amount of solid material embodied therein but for the present purposes carbon in an amount up to at least about 50% by weight may be incorporated and the sheet still handled satisfactorily by the present method. An amount in the range of 20% to 45% or even higher is particularly useful and practical. The particles are definitely discrete but may vary in size over a considerable range. For carbon a size in the range of 25 to 300 mesh is preferred. The carbon particles, particularly when present in the proportions indicated above, lie to large extent in the surfaces of the sheet and in effect project therefrom. As indicated earlier herein the carbon or other particulate material is conveniently incorporated in or applied to the wet pulp from which sheet **13** is formed. However, the material may be associated with the sheet by other means as for example by applying it to the surface, and if necessary or desirable by means of an adhesive, providing the adhesive does not deactivate the carbon or other material applied. In view, however, of the foregoing it is to be understood that in referring in the description and claims to the sheet being impregnated with the particulate material the terms includes the condition of the material being carried principally on the surface of the sheet and in fact that is an important characteristic in attaining the desired ultimate results.

The sheet material **14** has been described as being more or less plain paper. However, it may if desired be impregnated with a chemical capable of absorbing particular gaseous substances in the smoke not ordinarily captured by the powdered solid material contained in sheet **13**. The chemical selected and the mode of application should be compatible with the powdered solid material of the sheet **13** and particularly should be such as not to deactivate the powder. That is especially the case where carbon is the solid particle material embodied in sheet **13** as carbon quickly absorbs most migratory chemicals and is easily deactivated thereby. The chemical may be preembodied in the sheet material or roll **12** or in some cases a light impregnation thereof may be applied as part of the process in the apparatus of FIG. 1 as by spraying it on the strip **14**.

Continuing with the description of the mechanical apparatus and the operation the rolls **16** and **17** comprise an embossing means and, as shown particularly in the enlarged detail fragmentary view of FIG. 5, in the present apparatus they comprise complemental corrugating rolls having interfitting annular teeth and grooves. As the plied sheets pass theretrough they are compressed together with interdigitated surface areas, the carbon impregnated paper being closely compacted against the surface of the plain sheet material. The roll **19** may be provided with spiral grooves with the respective threads **19***a* and **19***b* advancing in opposite directions from the center toward each end as indicated in FIG. 2 thereby to aid in maintaining the plied laminated strip in relatively flat unwrinkled form except for the corrugations which have been impressed therein.

The degree of the corrugations or interleaving of the areas of the two parts may be varied and if desired one of the rolls **16** or **17** may be adjustable laterally with respect to the other roll, such as indicated at **22** for the roll **17**, to vary the amount of overlap or interference between the teeth of the respective rolls, this overlap being indicated in FIG. 5. A suitable arrangement comprises teeth having a height of about .040 inches and a width at the base line of substantially the same dimension, the overlap being adjusted to about .020 inches.

The mechanism for forming the plied strip into a cylindrical rod and applying an outer wrapper may vary in accordance with known practice and the illustration in that respect in FIG. 1 is merely representative and largely diagrammatic. As the plied strip **25** advances into the funnel or horn **20** is assumes a shape of which the cross section shown in FIG. 6 is illustrative. FIG. 6 pictures the strips **13** and **14** as separated in order to show more clearly the cross sectional configuration of these individual strips, but it should be understood that at this stage of the processing the strips **13** and **14** are normally in close interdigitated relationship. At the horn **20** the strip is picked up by a belt **30** extending over a series of rolls one or more of which may be positively driven in timed relation with rolls **16** and **17**. The rod or strip continues on through a further shaping garniture **31** and under a grooved pressure roll **32** and the shaped rod **25***a* progresses onto and along with a strip of outer wrapper paper **34** drawn from a supply roll **35**. The strip **34** and the overlying rod **25***a* are carried by a continuous belt **36** circulating over an upper guide **37** and a series of rolls including a drum **38**. The rod, including its outer wrapper strip advance through a garniture **39** where the outer wrapper is folded around the rod **25***a*, the rod continuing on past an adhesive applying means **40** including a roller or disc **40***a* which applies adhesive to a protruding edge of the wrapper and the rod continues through a device for folding down the edge including a heater **41** and a cooler **42**, and on past a cutter device **43** which cuts off the rod into segments of a suitable length.

As important features or characteristics of the overall method attention is directly particularly to the facts that the stronger sheet or strip **14** serves as a carrier for the weaker strip **13** and the latter is relieved of most of the stresses which would tend to loosen the carbon particles. As the plied strip proceeds into the folding and compacting horn **20** the strip **14** becomes an outer covering as well as carrier for the carbon impregnated strip **13**, as indicated in FIG. 6, and the sheet **14** receives the rubbing and frictional contact with the surfaces of the horn **20**. Also any loosened carbon particles remain enclosed within the strip **14**.

The exact relation of the layers within the finished rod will vary dependent upon the kinds and proportions of the sheet material and the number of layers of the respective type of sheet material. FIG. 6 indicates approximately the shape assumed initially in the process of laterally compacting the plied strip with the layer **14** enclosing the layer **13**, and FIG. 7 is intended to indicate generally a cross section of the final rod. A particular characteristic of the final rod is the pleating and interleaving of the two sheets together with the surface of the carbon impregnated sheet closely compacted against the surface of the plain absorbent sheet. This results both from the corrugating operation and the lateral compacting. As the strip advances past the section shown in FIG. 6 the edges **60** become folded inwardly more and the ultimate relation is somewhat like that shown at **61** in FIG. 7. Normally the plain paper is white and the carbon impregnated paper is a dark gray or black and the end section presents a sort of marbleized effect having areas of clear white among the black. Of importance is the fact that the carbon particles are compressed against the opposing plain paper and at least a multitude thereof occupy positions across the longitudinal passages which comprise smoke passages through the ultimate filter plug. In addition the transverse particles enhance the tortuousness of the smoke passages.

As indicated the exact character of the final filter rod will vary dependent on selection of the materials and the numbers of the respective plies. One modification in

this respect is shown in FIG. 4 in which the plies comprise a lower sheet 70 of plain paper, an intermediate strip 71 of the carbon impregnated material and an upper layer 72 of another plain sheet material which may be like that of the lower layer 70. In this form the carbon sheet is completely covered top and bottom, and fully protected against the mechanical or physical parts of the embossing and rod forming parts. Different effects may be obtained by lateral offsetting of the respective sheets.

Since various changes in carrying out the above method, and certain modifications in the product which embody the invention may be made without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. The method of forming a rod like filter comprising, forming a first strip of fibrous sheet material embodying solid particles of smoke filtering material exposed at the surface of the sheet, bringing the said first strip into superposed plied relation with a second strip of fibrous absorbent material but stronger in character and adapted to serve as a carrier for the first strip, simultaneously embossing the two strips in their plied relation to produce interdigitated surface areas of the two strips, compressing the plied and embossed strips laterally into a cylindrical rod, and applying an enclosing covering sheet thereto.

2. The method of forming a rod like filter comprising, forming a first strip of relatively weak fibrous sheet material impregnated with solid particles of smoke filtering material loosely held thereby and exposed at the surface of the sheet, bringing the said first strip into superposed plied relation with a second strip of fibrous absorbent sheet material but stronger in character and adapted to serve as a carrier for the first strip, simultaneously embossing the two strips in their plied relation to produce interdigitated surface areas of the two strips, compressing the plied and jointly embossed strips laterally into a cylindrical rod, and applying an enclosing covering sheet thereto.

3. The method of forming a rod like filter comprising, forming a first strip of fibrous sheet material embodying solid particles of absorbent carbon freely exposed at the surface of the sheet, bringing the said first strip into superposed plied relation with a second strip of fibrous sheet material stronger in character and adapted to serve as a carrier for the first strip, simultaneously embossing the two strips in their plied relation to produce interdigitated surface areas of the two strips, compressing the plied and embossed strips laterally into a cylindrical rod and applying an enclosing covering sheet thereto.

4. The method of forming a rod like filter comprising, forming a strip of thin sheet material impregnated with solid particles of a smoke filtering material some of which particles lie in and project from the surface of the sheet, bringing the impregnated sheet into plied relation with a carrier strip of fibrous sheet material, subjecting the plied strips to an embossing operation to produce interdigitated surface areas of the two strips whereby large numbers of the particles contact the opposed fibrous sheet and lie in the longitudinal path between the sheets, compressing the plied strips laterally into a cylindrical rod, and applying an enclosing covering sheet thereto.

5. The method of forming a rod like filter comprising, forming a continuous strip of thin sheet material impregnated with solid particles of carbon some of which particles lie in and project from the surface of the sheet, providing a continuous carrier strip of fibrous absorbent sheet material and advancing the two sheets together in superposed plied relation between complemental corrugating rolls having annular interdigitated teeth to produce interdigitated surface areas of the two strips whereby large numbers of the particles contact the opposed fibrous sheet and lie in the longitudinal path between the sheets, compressing the plied strips laterally into a pleated cylindrical rod, and applying and securing a covering sheet enclosing said rod.

6. The method of forming a rod like filter comprising, forming a first strip of fibrous absorbent sheet material embodying a chemical filtering medium, and a second strip of thin sheet material embodying discrete particles of carbon material some of which particles lie in and project from the surface of the sheet, bringing the two strips into superposed plied relation and subjecting the two strips simultaneously in plied relation to an embossing operation to produce interdigitated surface areas of the two strips whereby large numbers of the particles contact the opposed fibrous sheet and lie in the longtiudinal path betweent he sheets, compressing the plied strips laterally into a cylindrical rod, and applying an enclosing covering sheet thereto.

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