

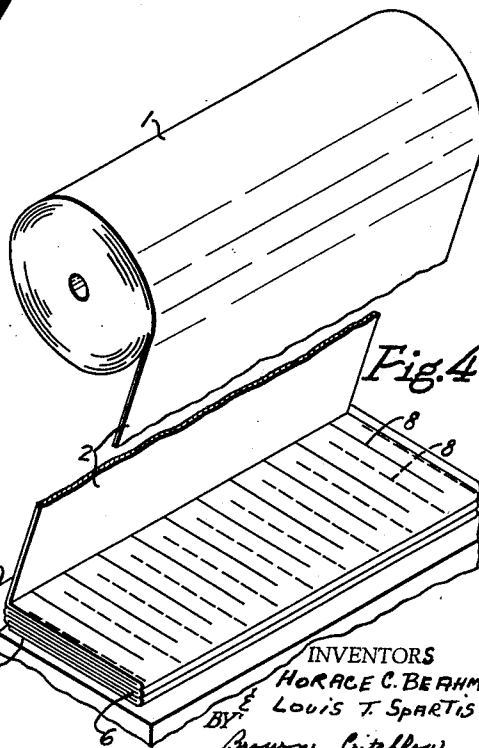
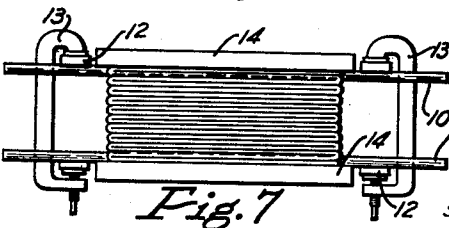
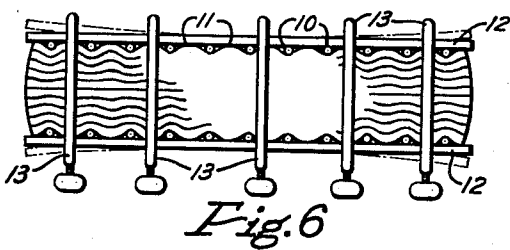
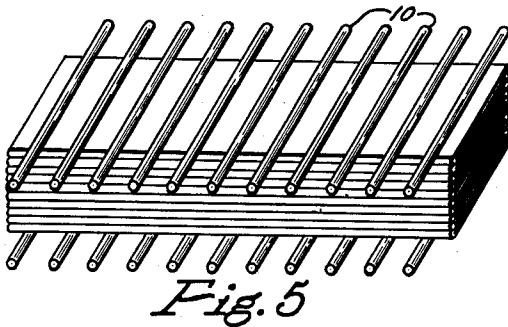
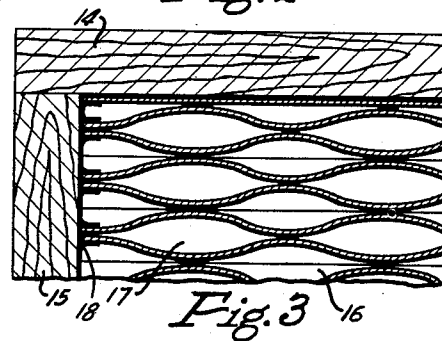
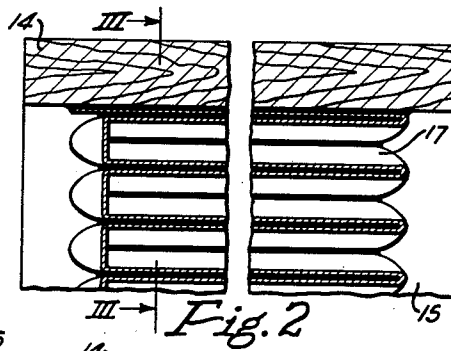
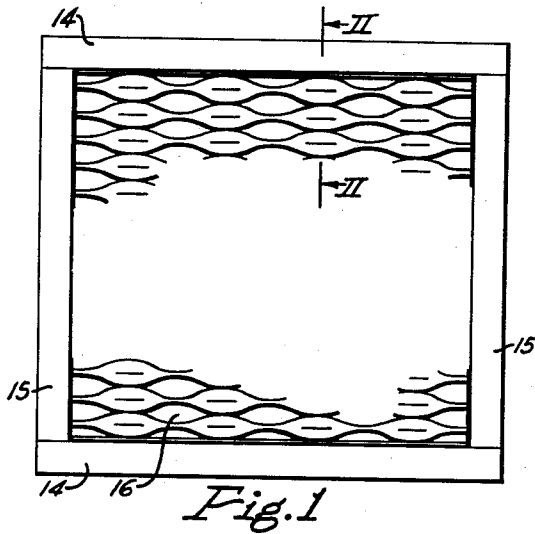
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METHOD OF MAKING ZIGZAG FILTER ELEMENT

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3,049,461

METHOD OF MAKING ZIGZAG FILTER ELEMENT

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4 Claims. (Cl. 156—197)

This invention relates to zigzag type filter elements, and more particularly to a method of making them.

In the copending application of Summers and Bub, filed September 29, 1958, Serial No. 763,948, an improved method of making filter elements is disclosed. A strip of filtering material is folded back and forth to form a stack of filter sheets that are joined together in such a way that when the stack is expanded filter pockets are formed between the sheets. That application points out that if the end sheets of a thick stack are secured flat to panels that later form sides of a filter frame, the filter element will neck down when the stack is expanded and be narrower at its center than at its opposite ends. That is because the end sheets, being secured to the panels, would be unable to contract and therefore would prevent the end pockets from opening as wide as those near the center of the filter. The copending patent application shows several ways to avoid that condition. The present application discloses still another way of insuring that all of the filter pockets will open to about the same extent and thereby prevent the element from necking down at the center when it is expanded.

It is therefore an object of this invention to provide a method of making a zigzag filter element, in which the filter element will have substantially the same width throughout its length when it is expanded.

In accordance with this invention, a long strip of flexible filter material is folded transversely back and forth upon itself to form a stack of sheets. Each pair of adjoining sheets are joined together along a row of laterally spaced lines that extend lengthwise of the strip. The lines in each row are staggered relative to the lines in the row at opposite sides of it. A row of laterally spaced rods is placed against each end sheet of the stack opposite the joining lines at the other sides of the sheet. Pressure is applied to the rods to compress the stack in order to form waves in the end sheets and to shorten them. A pair of panels are then joined to the shortened end sheets along the crests of their waves while the pressure on the rods is maintained. Thereafter the rods are removed endways from between the panels and end sheets, following which the stack is expanded to form filter pockets between the sheets in the areas that are not joined together.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which:

FIG. 1 is a face view of a complete filter, in which the filter element was made by our method;

FIG. 2 is an enlarged, fragmentary section of the filter taken on the line II—II of FIG. 1;

FIG. 3 is a fragmentary section of the filter taken on the line III—III of FIG. 2;

FIG. 4 is a perspective view showing how the filter element stack is made;

FIG. 5 is a perspective view of the stack with rods applied to its opposite ends;

FIG. 6 is a side view of the stack showing pressure being applied to the rods;

FIG. 7 is an end view showing panels secured to the end sheets of the compressed stack between the rods; and

FIG. 8 is a side view of the stack after pressure has been removed from it.

Referring to FIG. 4 of the drawings, a roll 1 of flexible

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filter material, such as a long strip 2 of filter paper, is rotatably supported on a horizontal axis. The free end of the strip is pulled down to a suitable flat support 3. A predetermined length of the end portion of the strip then is laid down flat on the support and held there while the strip is folded back over it in the opposite direction. A flat filter sheet 4 is thus formed in engagement with the support. At the free edge of that sheet the strip is folded again, whereby a second sheet 5 is formed on top of the first sheet, and a third sheet 6 is started. This folding back and forth is continued until a stack is formed containing the desired number of sheets. However, an intermediate operation is performed before each successive sheet is formed after the first one. This operation consists of joining each pair of adjoining sheets together along a row of laterally spaced lines that extend lengthwise of the strip.

This joining may be done in different ways, such as by stitching or stapling, but a simple way of doing it is to paint lines of adhesive 8 on the upper surface of each sheet. This can be done quickly with the help of a stencil, template, marking device or other suitable means. The line does not have to be continuous, but can be made up from a row of dots. After the adhesive has been applied to a sheet, the next sheet is folded down onto it so that the two sheets will be stuck together along the lines. The adhesive lines on successive sheets are staggered so that each row of lines is offset relative to the rows of lines directly above and below it. For best results with a rectangular filter element, the offset should be substantially half the distance between lines in any given row.

After the stack of sheets has been completed and they have all been joined together in the manner just described, the top sheet is cut from the strip hanging from the roll. As shown in FIG. 5, a row of stiff parallel rods 10 is then placed against each end of the filter stack. The rods extend parallel to the lines 8 that join the sheets, each rod extending along a line on the opposite side of the end sheet. The next step is to apply pressure to the rods in order to press them into the stack of sheets between the two rows, thereby causing the end sheets to bulge out between the rods to form waves 11 as shown in FIG. 6. If the distance across the stack lengthwise of the rows of rods is not very great, pressure can be applied more or less uniformly to all the rods at one time and the end sheets will pull in or contract and form the desired waves. However, if the distance just mentioned is great, it is highly desirable that the pressure be applied to the center rods first and then progressively outward toward the opposite ends of the rows, as indicated in dotted lines in FIG. 6. In this way there will be nothing to restrain contracting or shortening of the end sheets as the rods are pressed tightly against them.

In order to apply pressure to the rods, they are made long enough to project from opposite sides of the stack so that the pressure can be applied to their projecting ends. This can be done in various ways by clamps and the like. For example, somewhat flexible bars 12 (FIG. 6) may be laid along the projecting ends of the rods and then clamps 13 applied to the central portions of the bars to force the central rods toward each other. Further clamps are then applied progressively outward along the bars toward their opposite ends until the bars are straight and all of the rods press into the stack about the same distance.

While the stack is maintained under pressure in this manner, adhesive is applied along the crests of the waves 11 between the rods and then rigid flat panels 14 (FIG. 7) are pressed against the rods to cause the end sheets of the stack to stick to the panels. After the adhesive has dried or set so that the end sheets will remain securely attached to the panels, the pressure clamps are

removed and the rods are pulled endways out from between the panels and the stack of filter sheets. It will be seen in FIG. 8 that the edges of the stack between the panels are convex, due to the end sheets being contracted. The two panels then are pulled away from each other far enough to expand the entire stack, somewhat like an accordion, into a filter element and two more flat panels 15 shown in FIGS. 1, 2 and 3 are then inserted between the ends of the first panels to hold them apart and complete a frame for the filter element. Since the sheets will not separate along the lines 8 where they are joined together, the areas of the sheets between those lines will be pulled apart to form parallel pockets. About half of the pockets 16 will have their open ends at one side of the filter and the other half 17 will have their open ends at the opposite side. As the stack of sheets is expanded, the sheets between the end sheets will be contracted as the pockets open up, and the filter element will take a rectangular form with substantially parallel sides, instead of concave sides, adjoining panels 15.

After fastening the adjoining ends of the four panels together to form a rigid frame, panels 15 are masked and first one and then the other is dipped into a sealing compound to provide sealing material 18 between the edges of the filter sheets and those panels, as shown in FIG. 3.

According to the provisions of the patent statutes, we have explained the principle of our invention and have illustrated and described what we now consider to represent its best embodiment. However, we desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. In the method of making a zigzag filter element having filter sheets between end panels, the steps comprising transversely folding a long strip of flexible filtering material back and forth upon itself to form a stack of sheets while successively joining each pair of adjoining sheets together along a row of laterally spaced lines that extend lengthwise of the strip, the lines in each row being staggered relative to the lines in the rows at opposite sides of that row, placing a row of laterally spaced rods against each end sheet of the stack opposite said lines at the opposite side of the same sheet, applying pressure to said rods to press them into said stack and thereby form waves in the end sheets and shorten them, joining a pair of panels to the end sheets along the crests of their waves while said pressure is maintained, removing said rods endways from between the panels and end sheets, and then expanding said stack to form filter pockets between the sheets in the areas that are not joined together along said lines.

2. In the method of making a zigzag filter element having filter sheets between end panels, the steps comprising transversely folding a long substantially uniform width strip of flexible filtering material back and forth upon itself to form a stack of substantially flat sheets while successively joining each pair of adjoining sheets together along a row of laterally spaced lines that extend lengthwise of the strip, the lines in each row being staggered relative to the lines in the rows at opposite sides of that row, placing a row of laterally spaced rods against each end sheet of the stack opposite said lines at the opposite side of the same sheet and with the ends of the rods projecting beyond the edges of the sheets, applying pressure to the projecting ends of the rods to compress said stack and thereby form waves in the end

sheets and shorten them to provide the stack with convex surfaces at the side edges of said strip, joining a pair of panels to the shortened end sheets along the crests of their waves while said pressure is maintained, removing said rods endways from between the panels and end sheets, and then expanding said stack to straighten said convex surfaces and to form filter pockets between the sheets in the areas that are not joined together along said lines.

3. In the method of making a zigzag filter element having filter sheets between end panels, the steps comprising transversely folding a long strip of flexible filtering material back and forth upon itself to form a stack of sheets while successively joining each pair of adjoining sheets together along a row of laterally spaced lines that extend lengthwise of the strip, the lines in each row being staggered relative to the lines in the rows at opposite sides of that row, placing a row of laterally spaced rods against each end sheet of the stack opposite said lines at the opposite side of the same sheet, applying pressure to the center rods in said rows and then progressively outward along the rows to the end rods to thereby compress the stack and form waves in the end sheets and shorten them to provide the stack with convex surfaces at the side edges of said strip, joining a pair of panels to the shortened end sheets along the crests of their waves while said pressure is maintained, removing said rods endways from between the panels and end sheets, and then expanding said stack to form filter pockets between the sheets in the areas that are not joined together along said lines.

4. In the method of making a zigzag element having filter sheets between end panels, the steps comprising folding a short length of a long strip of filtering material transversely upon itself to form a pair of sheets, joining said sheets together along a row of laterally spaced lines that extend lengthwise of the strip, folding the strip in the opposite direction to provide a third sheet overlying the adjoining one, joining said third sheet and adjoining one together along a row of laterally spaced lines that extend lengthwise of the strip between the lines in the first row, repeating said folding and joining until a stack of the desired number of sheets has been provided, applying pressure to each end sheet of the stack along laterally spaced lines opposite to said joining lines at the inner side of each end sheet to form waves in the end sheets, and said waves having crests between said pressure lines, joining a pair of panels to the end sheets along the crests of their waves while said pressure is maintained, releasing said pressure, and then pulling the panels away from each other to separate the unjoined areas of all of the sheets to form filter pockets between the sheets.

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