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METHOD OF MAKING FILTERS

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Fig. 1.

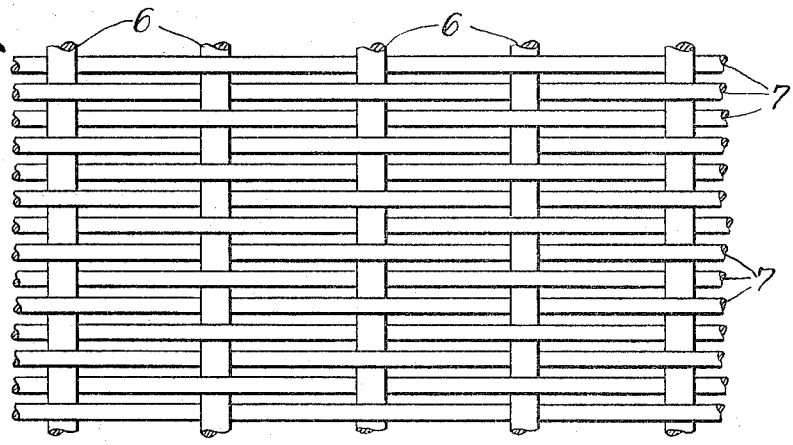


Fig. 2.

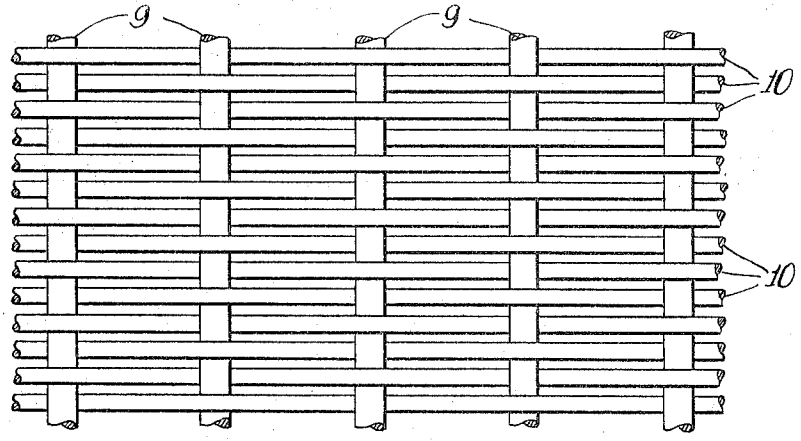
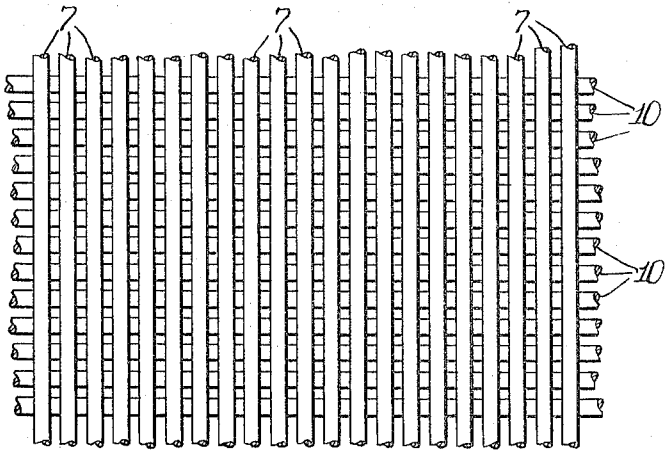


Fig. 3.



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METHOD OF MAKING FILTERS

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The present invention relates to a method of making filters.

It is known that a filter may be made by combining two or more fabrics as, for example, first and second fabrics, each of which is composed of a first set of substantially parallel filaments, and a second set of substantially parallel filaments extending transversely of the filaments of the first sets, and of which the filaments of the first sets are more easily destructible than the filaments of the second sets. Such first and second fabrics may be disposed in superimposed relation with their second sets of filaments in crossing relation, the crossing portions joined to each other, as by sintering, and then destroying the first sets of filaments of the first and second fabrics to thus provide a filter composed of the filaments of the second sets in crossing and joined relation.

A filter fabricated as aforenoted is satisfactory for many filtering purposes but has some limitations as to mesh fineness by reason of the presence of so called "knuckles" which are inherently formed at the crossing portions of the joined filaments in the completed filter.

An object of the present invention is to provide a method by which the mesh or openings of a filter produced as above described may be easily and conveniently uniformly reduced in size to provide finer mesh filters.

The foregoing object may be achieved by compressing a filter after fabrication of the same as above described to reduce the mesh or hole size of the filter by flattening the crossing portion of the filaments as by calendering the filter or by the application of pressure simultaneously and uniformly over the entire surfaces of the filter.

A further object of the present invention is to provide a method embodying the step of re-sintering a filter fabricated as above described before, during or after the foregoing compressing step to render the end filter more rigid and effect a stronger bond between the joined crossing portions of the filaments.

As noted the crossing portions of the second sets of filaments of the first and second fabrics are joined by a first sintering step. In such first sintering step, the first sets of destructible filaments are present and the sintering must be effected at a temperature at which undue diffusion of the materials of the several filaments does not occur and which does not deleteriously affect the filaments which form the end filter. The second or re-sintering step of the present invention may be effected at a much higher temperature and for a shorter period of time than the aforementioned first sintering step. Also reducing gas under which sintering is carried out is more effective at a higher temperature and need not be as free of oxygen and moisture as is necessary for the lower temperature sintering step in the initial joining of the crossing portions of the second sets of filaments of the first and second fabrics.

A preferred feature of my invention resides in the utilization of one or more Dutch weave fabrics so as to provide filters of extremely fine mesh or hole size.

The above noted and other objects, advantages and features of the invention will appear from the following detailed description of a preferred embodiment of the invention.

In order to more clearly describe the present invention, there is described below, in connection with the accompanying diagrammatic drawing, a preferred embodiment of the method of the invention.

In the drawing:

FIGURE 1 is a diagrammatic plan view of a first fabric suitable for use as one component in practicing the method of the invention for fabricating a filter;

FIGURE 2 is a diagrammatic plan view of a second fabric suitable as another component in practicing the method of the present invention for forming a filter; and

FIGURE 3 is a plan view of a filter formed by the fabrics of FIGURES 1 and 2 in accordance with the method of this invention.

Referring now to the drawings, FIGURE 1 shows a first fabric **5** which is composed of a first set of parallel warp filaments **6** and a second set of parallel weft of crossing filaments **7**. In respect to one embodiment of the present invention the warp filaments **6** may be made of material relatively more easily destructible than the material of the weft filaments **7**.

In FIGURE 2, there is shown a second fabric **8** comprising a first set of parallel warp filaments **9**, and a second set of parallel weft or crossing filaments **10**, and again in a typical application of the method of this invention the warp filaments **9** may be made of material relatively more easily destructible than the material of the weft filaments **10**. The fabrics **5** and **8** may be combined to form a filter by superposing one upon the other with the warp filaments **6** and **9** in crossing relation and with the second set of weft filaments **7** and **10** in crossing relation. The crossing portions of the weft filaments **7** and **10** of the two fabrics **5** and **6** in the superposed relation noted may be joined together as by a sintering step, and after which the warp filaments **6** and **9** are removed as by melting, dissolution or in any other suitable manner.

The filter **11** resulting from the above steps, as shown in FIGURE 3, thus comprises a first set of parallelly spaced apart filaments **7** and a second set of parallelly spaced apart filaments **10** extending transversely of the filaments **7** with the several filaments **7** and **10** being joined at their crossing portions.

It will be understood that two or more fabrics may be joined to form a filter there being no difference whether the warp or weft of the fabrics are removed so long as the removal involves only filaments of one fabric which are not in line with the filaments of another fabric which are removed.

With a filter **11** produced as above described, the method of the above invention concerns the steps of compressing the same to flatten the crossing portions of the filaments of the filter and again sintering the filter before, during or after the compressing step.

In a preferred embodiment of the invention, the first and second fabrics, such as fabrics **5** and **8**, may be composed of 150 parallel warp wires 6 and 9 per inch, and 900 parallel weft wires 7 and 10 per inch, respectively. The warp wires **6** and **9** may, for example, be fabricated of carbon steel containing .89% carbon and measuring .0021 inch in diameter. The weft wires **7** and **9** may be fabricated of type 304 stainless steel and measuring .0012 inch in diameter. The two fabrics may then be disposed with their warp and weft wires in crossing relation and sintered in a reducing atmosphere, such as hydrogen, at a temperature of 1900° F. for three hours. In the sintering step, the temperature should be such so as to prevent undue diffusion of the nickel from the stainless steel weft wires into the carbon steel warp wires. If appreciable diffusion occurs, it becomes difficult to dissolve the warp wires and also the corrosion and physical characteristics of the remaining stainless steel weft wires may be deleteriously affected. The last described fabrics are, as is

well known in the art, referred to as "Dutch weaves" or completely filled fabric, in that there are more ends in the weft direction than can be laid side by side in a given length of fabric. In the fabrics above described, there are 900 ends of .0012 inch wire per inch, which, if arranged in side-by-side abutting relation, would measure 1.08 inches. However, in Dutch weaves or filled fabric, the weft wires do not lay side by side but laterally overlap each other in their lengthwise direction to a small degree. It will be understood that the accompanying drawing is diagrammatic and for purposes of clarity the weft wires are spaced apart although actually as noted the adjacent weft wires laterally overlap each other slightly in their lengthwise directions. After sintering of the combined pair of fabrics, the warp filaments may be removed by immersion in a bath of nitric acid and water in the ratio of two parts to one part, respectively, at a temperature of 170° F. for three to four minutes. It should be noted that in filled fabric or Dutch weaves, that the weft wires touch each other at a number of points, and therefore are stable dimensionally, since there is no space to allow the crossing portions of the weft wire to tip into. In the preferred embodiment of the present invention, it is preferable to employ Dutch weave fabrics or filled fabrics and they may be woven or jig formed as desired.

The filter **11** thus above produced will be of a thickness of about 7.6 mils, and will have a mesh or hole size of about 27 microns.

In accordance with the present invention, a filter, such as filter **11** above described, is subjected to a compressing step to press the crossing portions of filaments **7** and **10** together as by calendering or subjecting the filter to the application of simultaneously uniform pressure over the entire surface areas of the filter. For example, by subjecting the filter **11** to a pressure 22,950 p.s.i. it may be reduced to a thickness of 3.3 mils and with a resulting mesh or hole size of 15 microns.

Further in accordance with the method of this invention, a filter **11** constructed as above described before, during or after the foregoing compressing step may be re-sintered after removal of the expendable warp wires. Typically in the example noted, the filter **11** may be re-sintered at a higher temperature than the initial sintering temperature, for example, at a temperature 2,200° F. in a hydrogen atmosphere, and for a period less than the period of time of the initial sintering, as, for example, for about one hour. At this re-sintering temperature the bond growth of the crossing portions of the weft wires is about three times as fast as that of the initial sintering temperature of 1900° F. The resulting bond strength is greatly enhanced and effects substantial increase in the stiffness of the filter. The higher re-sintering temperature also permits faster diffusion and cuts down the processing time and, in addition, at the elevated temperature, the hydrogen is more reducing than at the lower initial sintering temperature, and does not need to be as free of oxygen and moisture as required at the lower initial sintering temperature.

The foregoing is a typical example of the method of the invention, and it will be understood that the several facts above noted may vary, depending upon the following factors:

(1) The size of the warp weft wires.

(2) The mesh or hole count.

(3) Metal analysis and combination of metals.

(4) Amount of overfill in Dutch weave or filled fabrics.

(5) The construction or configuration of the fabrics.

While a preferred form of the method of the present invention has been above described, it will be understood that various modifications may be made therein without departing from the spirit and scope of the invention.

The invention claimed is:

1. In the method of making a filter formed by combining first and second fabrics, each of which is composed of a plurality of first metal filaments and a plurality of second metal filaments in crossing relation with respect to each other, and in which said first and second fabrics are arranged with their second metal filaments in crossing relation, the steps comprising joining said second metal filaments at their crossing portions by a first sintering step, removing said first filaments of said first and second fabrics, and then compressing said filter to flatten the crossing portions of said second filaments of said first and second fabrics.

2. The method of claim **1** characterized by the step of re-sintering said filter after compressing the same.

3. The method of claim **2** in which the first metal filaments of said first and second fabrics are composed of carbon steel, in which said second filaments of said first and second fabrics are composed of stainless steel, and in which said first filaments of said first and second fabrics are removed by dissolving the same.

4. The method of claim **3** in which said first filaments of said first and second fabrics are joined at their crossing portions by sintering at a temperature of 1900° F. for about three hours, in which compressing of said filter is performed at a pressure of at least 22,950 p.s.i., and the filter re-sintered at a temperature of 2200° F. for about one hour.

5. The method of claim **4** characterized by said second filaments of at least one of said first and second fabrics lying in laterally overlapping relation in their lengthwise direction.

6. The method of claim **5** in which said first filaments of said first and second fabrics are about .0021 inch in diameter, in which said second filaments of said first and second fabrics are about .0012 inch in diameter, and said filter after compressing the same being of a thickness of about 3.3 mils providing of a hole size of about 15 microns.

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