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2,359,475

METHOD OF MAKING FILTER ELEMENTS

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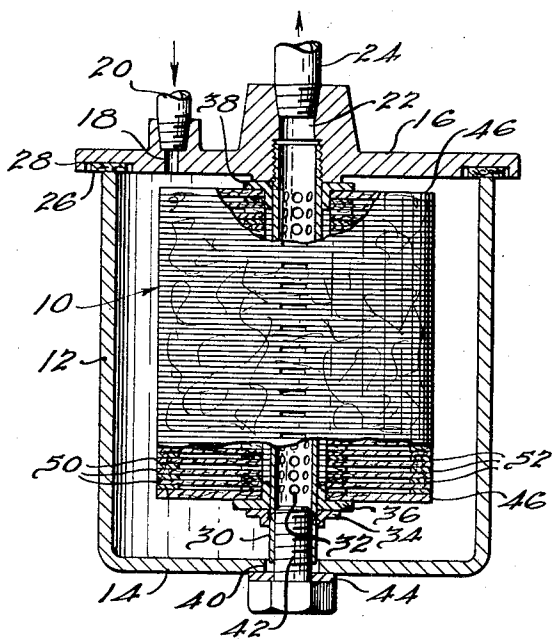


FIG. 1.

FIG. 2.

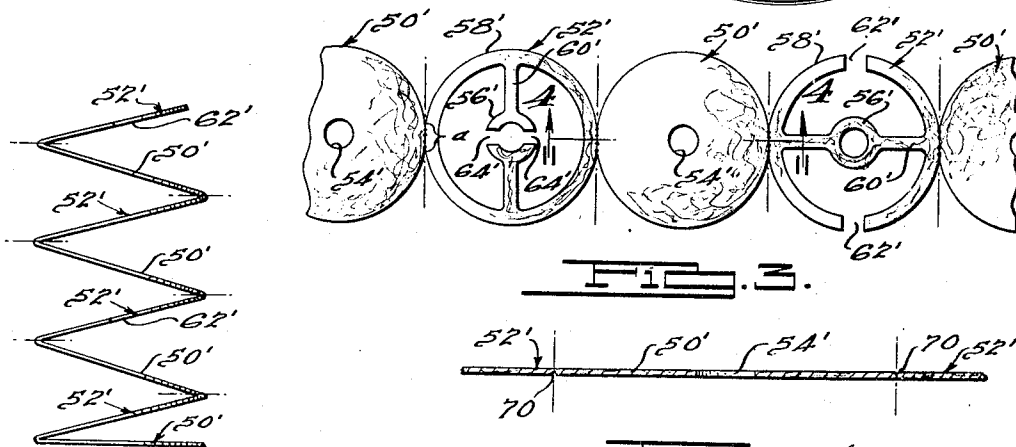
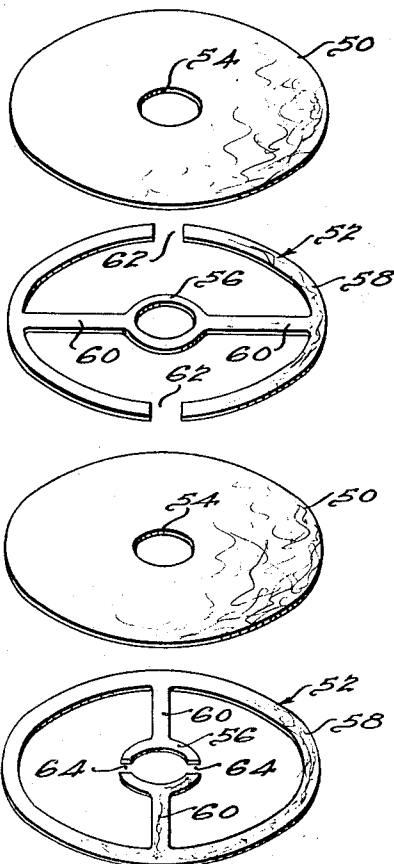


FIG. 3.

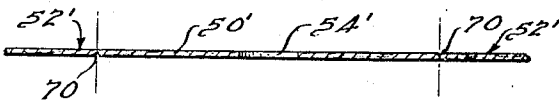


FIG. 4.

FIG. 5.

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METHOD OF MAKING FILTER ELEMENTS

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7 Claims. (Cl. 210—169)

This invention relates to filters and particularly to filter packs, and has for its principal object the provision of a construction that is easier and, therefore, more economical to assemble and manufacture and is of improved appearance.

Objects of the invention include the provision of a filter pack having a central opening and comprising a plurality of filtering members or elements superposed alternately with intercalary members and forming a plurality of chambers, the intercalary members each comprising inner and outer members of annular or equivalent shape arranged in spaced relation with respect to each other and alternate intercalary members being broken through their outer edges and inner edges respectively so as to alternately provide direct communication of the spaces thus provided between the filtering elements alternately with the exterior of said pack and with the central opening of said pack; the provision of a construction as above described in which the inner and outer members of each intercalary member are connected together to thereby form a single unit; the provision of a construction as above described in which the inner and outer annuli of each intercalary member are connected together by one or more radially extending webs or spokes; the provision of a construction as above described in which the spaces between the inner and outer annuli of alternate intercalary members on each side of said web are connected with the exterior of the pack by breaks through the outer annuli; the provision of a construction as above described in which the spaces between the outer and inner annuli of alternate intercalary members on each side of the web thereof are connected with the central opening by breaks through the inner annuli; the provision of intercalary members of the type described that are of one-piece construction; and the provision of a filter pack of the type described secured together in a novel manner.

Other objects of the invention include the provision of a filter pack of the type described in which adjacent filtering and intercalary members are integrally joined together; the provision of a filter pack of the type described in which the adjacent filtering and intercalary members are hingedly connected together; and the provision of a filter pack of the type described in which a filtering member is hingedly secured at one point in its periphery to the intercalary member adapted to overlie one face thereof and is hinged at a point diametrically opposite the first mentioned point to that intercalary member adapted to overlie the opposite face thereof.

Further objects of the invention include, in the manufacture of a filter pack of the type described, the steps of operating upon a strip of material suitable for said filtering elements or

members and the intercalary members to form a strip comprising alternate filtering and intercalary members with each of said members connected to the next adjacent members by a portion integral with both thereof, and then folding said members in zig-zag relation into the desired pack form; and the step in the manufacture of a filter pack of the type described from integrally joined filtering and intercalary members, of scoring the strip at the lines of junction between two elements or members alternately on opposite sides of the strip whereby to provide a natural line of fold serving as a hinge between the members and facilitating the arrangement thereof in packs.

The above being among the objects of the present invention the same consists in certain novel features of construction, combinations of parts, and step or steps of operation to be hereinafter described with reference to the accompanying drawing, and then claimed, having the above and other objects in view.

In the accompanying drawing which illustrates suitable embodiments of the present invention and in which like numerals refer to like parts throughout the several different views,

Fig. 1 is a partially broken vertical sectional view taken axially through a filter embodying a filter pack constructed in accordance with the present invention;

Fig. 2 is an enlarged exploded view illustrating in perspective the various types of elements going to make up the filter pack employed in the filters shown in Fig. 1;

Fig. 3 is a fragmentary plan view of a form of blank applicable for use in forming a filter pack in accordance with the present invention and in which the alternate filter and intercalary members are integrally joined together;

Fig. 4 is an enlarged, fragmentary sectional view taken on the line 4—4 of Fig. 3 and illustrating the preferred method of scoring the blank of Fig. 3; and,

Fig. 5 is a more or less diagrammatic view illustrating the manner of folding the blank shown in Fig. 3 in producing a filter pack therefrom.

The present invention relates to filter packs of the general type disclosed and claimed in United States Letters Patent No. 2,190,014, issued February 13, 1940, to Jacques Colas on Filter pack. In other words it comprises a filter pack of more or less annular formation comprising alternate filtering and intercalary members placed one upon the other to form the pack, the intercalary members spacing the filtering members to form a pocket or chamber between each adjacent pair of filtering members, and the intercalary members being alternately open to

the radially exterior and radially interior faces of the pack.

In the Colas patent above identified the intercalary members comprise annuli, alternate ones of which are relatively small and space the cooperating filter members at their centers, and the remainder of which are of the same outside diameter as the filtering members and space the cooperating filtering members at their outer edges. It is to be noted that in the construction of the above identified Colas patent the filtering members between which the small intercalary members are interpositioned are in actual contact at their outer edges and those filtering members between which the large intercalary members are interpositioned are in contact with each other at their centers. These intercalary members are broken in their circumference to form ports to the pockets or chambers between their cooperating filtering members, those ports in the small annuli leading to the central bore of the filter pack and those in the large annuli leading to the exterior surface of the filter pack. Inasmuch as the filtering members and the intercalary members are assembled by threading them on a pilot tube of a size to fit the bore of the filtering members and of the small annuli intercalary members, it will be appreciated that the large annuli intercalary members being internally of much greater size than the diameter of the pilot tube must be lined by hand with the filtering members, and because of the inevitable misalignment bound to occur under such conditions in assembly the exterior surface of the finished pack is inevitably rough and unfinished in appearance. Furthermore, because of the fact that alternate filter members actually contact each other at their inner and outer edges, which contact inevitably extends radially outwardly and radially inwardly, respectively, to a greater distance than the radial dimensions of the corresponding intercalary members, the effective area of the filtering members is unnecessarily restricted and is open to being unnecessarily plugged by the building up of filter cake thereon.

The present invention has for its principal object a construction overcoming the above discussed disadvantages of the construction shown and described in the above identified Colas patent. This is accomplished by forming each intercalary member both with an inner and outer annulus thus spacing the cooperating filtering members by the full thickness of the intercalary member for the full distance between the inner and outer annuli. Moreover the construction is such as to permanently connect the inner and outer annuli of each intercalary member together, as by an interconnecting web or spoke, which preferably is integral with both. The inner annuli of each intercalary member having an inner diameter such as to be relatively closely received by the pilot tube, it automatically acts to center the outer annulus of each intercalary member with the cooperating filtering members. This web or spoke is preferably extended radially between the annuli of each intercalary member and preferably the web extends in two or more directions radially outwardly from the inner annulus to the outer annulus. As a result of this construction the concentricity of the inner and outer annulus of each intercalary member is assured as well as the concentricity of the outer annulus with the cooperating filtering members in following out the normal method of assembly upon a pilot tube. It, therefore, eliminates any requirement of skill in the

workman performing the assembly and results in a filter pack having a small exterior surface. Moreover, by completely spacing the filtering members between the inner and outer annuli, except over the area of the webs or spokes which in themselves serve as supports between the inner and outer annuli and aid in preventing contact of the filtering members between the annuli through sagging, the effectiveness of the filtering members is increased as compared to the construction of the Colas patent.

Referring now to the accompanying drawing, a complete filter including a pack constructed in accordance with the present invention is illustrated in Fig. 1. In this connection it will be appreciated that the particular construction of the housing in which the pack is located and the manner of supporting the pack therein may be varied to suit the desires of the particular designer or manufacturer and may vary according to the condition of use and liquid to be filtered, the particular construction shown for the purpose of enclosing and supporting the filter pack being merely by way of illustration. In Fig. 1 the filter pack is indicated generally at 10 and is shown as being enclosed in a cup-shaped housing 12 having a bottom wall 14 and an open upper end. It will, of course, be appreciated that in use the liquid may be passed through the pack from the center outwardly or from the outside to the center, the latter condition being assumed for the purpose of explanation. The top of the housing 12 is closed by a cover plate 16 having an inlet passage 18 therethrough in the outer end of which a pipe or tube 20 is threaded for conveying the liquid to be filtered thereto. The cover 16 is provided with an outlet passage 22 in the outer end of which a pipe or tube 24 is threaded and which serves to convey the filtered liquid away from the filter. The cover 16 is sealed to the housing 12 by means of a gasket 26 received in an annular groove 28 formed in the lower face of the cover 16 in concentric relation with respect to the walls of the housing 12.

The filter pack 10 is provided with a central bore therethrough in which a tube 30, provided with a multiplicity of perforations 32 over that length thereof confined within the pack 10, is relatively loosely received so as to form an annular passage between it and the bore of the filter pack. The upper end of the tube 30 is threaded into the lower end of the bore 22 in the cover 16. Below the filter pack 10 the tube 30 is provided with an outwardly directed flange 34 fixed thereto between which and the bottom end of the filter pack 10 is positioned a gasket 36 surrounding the tube. A similar gasket 38 is positioned between the upper end of the filter pack 10 in surrounding relation with respect to the upper end of the tube 30. The gaskets 36 and 38 are each relatively closely but slidably received on the tube 30 and each has an extended neck portion of reduced diameter which fits in the bore of the filter pack to thereby center it on the tube 30. Thus the filter pack 10 when positioned on the tube 30 is supported from the cover 16 and is compressed to a greater or lesser extent axially thereof by threading the tube 30 upwardly into the cover 16 thereby to compress the gaskets 36 and 38 against the opposite ends of the pack to seal the ends of the pack 10 to the opposite ends of the tube 30. The bottom wall 14 of the housing 12 is provided with an opening 40 therein through which a bolt 42 is projected upwardly and threaded into the bore of the tube 30, the head of the bolt bearing

against the bottom wall 14 through the interposition of a suitable sealing gasket 44. The bolt 42, acts through the tube 30 to pull the cover 16 downwardly into sealing relation with respect to the housing 12. Thus the tube 30 not only serves the function of an oil passage for conducting the filtered fluid out of the filter but also as a means for aiding in the securing of the cover 16 to the housing 12.

The filter pack 10 which comprises the subject matter of the present invention and except for the two opposite end members 46 which are preferably made up from relatively heavy and/or rigid material adapted to take the compressive strains applied thereto when clamping the pack 10 in place in the filter, is made up of alternate filtering elements or members 50 and intercalary members indicated generally at 52. While it will be appreciated that the pack 10 may be of any suitable cross-sectional configuration, as for instance square, octagonal, round, or the like, it is preferably made of the latter shape and is so illustrated in the drawing, reference made hereinafter to such shape being descriptive of the particular shape shown in the drawing but not limiting the invention to a filter pack or members or elements thereof of circular conformation.

The filter members 50, which are best brought out in Fig. 2, are in the particular case shown of disc-like character each having a central opening 54 for the purpose of receiving the tube 30. The intercalary members 52 each comprise an inner annulus 56 and an outer annulus 58 and in accordance with the present invention these two annuli are connected together by means of one or more webs or spokes 60. Preferably the webs 60 are formed integrally with the annuli 56 and 58 as indicated so that each intercalary member 52 may be stamped in one piece out of a single sheet of material. The annuli 56 and 58 are arranged concentrically with each other and in radially spaced relation which relation is maintained by the webs 60. While one or more webs 60 may be employed in the broader aspects of the present invention, two webs arranged diametrically of each intercalary member as shown are preferably employed. The internal diameter of the inner annulus 56 of each intercalary member 52 is of the same size as the openings 54 in the filter members 50 and is concentric therewith in the completed pack. The outer annulus 58 of each intercalary member 52 is preferably of an outer diameter equal to the outer diameter of the filter discs 50.

It will be appreciated that by interposing an intercalary member 52 between each pair of filter members 50, the filter members 50 are spaced from each other by the thickness of the intercalary members 52 and in the particular construction shown a pair of chambers or pockets, one on each side of the webs 60, are thus provided between each pair of filter members 50.

Alternate intercalary members 52 have portions of their outer annulus 58 broken away as at 62 to provide passages or ports from the exterior of the filter pack to the pockets thus formed therein between the cooperating filter members 50. The remaining intercalary members 52 having their inner annulus 56 broken away as at 64 to provide passages or ports from each of the associated pockets to the bore of the pack 10 and, therefore, to the perforated tube 30. Thus liquid under pressure introduced into the casing 12 may find its way through the ports 62 in alternate intercalary members 52 to the

space between alternate pairs of filtering members 50 and, after passing axially through such filtering members into the space between such filtering members and their next adjacent filtering members, may flow through the ports 64 into the space around the tube 30 and thence through the openings 32 therein to the interior of the tube and be discharged from the filter through the passage 22. It will be appreciated that the filter pack thus provides a large area of filtering surface for its size as such filtering area is equivalent to the combined areas of the discs 50 less that portion thereof overlain by the intercalary members 52.

The webs or spokes 60 of alternate intercalary members 52 are preferably, but not necessarily, angularly spaced from each other by 90 degrees. This is so the webs or spokes 60 of those intercalary members 52 having the ports 64 will support and space the cooperating filter discs 50 in line with the ports 62 of the remaining intercalary members and, likewise, the webs or spokes of these remaining intercalary members will support the cooperating filter discs 50 in line with the ports 64 of the first mentioned intercalary members. This feature, therefore, aids in preventing the collapse of two adjacent filter discs in line with the ports 62 or 64 for the space between them. Another advantage of this arrangement is that the ports 62 and 64 of alternate intercalary members are angularly spaced from each other by 90 degrees and this aids in preventing the building of filter cake at the entrance ports.

The intercalary members 52 serving no filtering function themselves may, of course, be made of any suitable material capable of properly spacing the filter members 50 and unaffected by the liquid to be filtered. They may, of course, be made up of one thickness or several thicknesses of material. Likewise they may be of the same thickness as the filtering discs 50 or they may be of greater or lesser thickness. They may be made from metallic or non-metallic material as desired. It will be preferable in most cases, however, if the intercalary members 52 are made from the same material as the filtering discs 50 as this simplifies the stock of materials required to be kept on hand in the manufacture of the filter packs.

The filtering discs 50 may be made up of one or more thicknesses of suitable material capable of meeting the problem involved in any particular case. In other words the porosity of the material will ordinarily vary according to the size of the particles required to be filtered out thereby and, of course, such material must not be affected adversely by the materials to be filtered thereby. In the broader aspects of the invention the material from which the discs 50 are formed may be leather, fabric, or other suitable fibrous materials. Preferably but not necessarily in all cases such material should have sufficient inherent rigidity to maintain the pockets in the intercalary members. I have found that where petroleum products are to be filtered, such as gasoline, fuel oil, or lubricating oil, the filter discs 50 may be formed from suitable grades of paper or paper stock. Preferably where such paper or paper stock is employed it should be of a type not materially affected by the small amounts of water that occasionally find their way into petroleum products.

Paper made from Halfa or Esparto stock, or the equivalent, is particularly adaptable for use

in this connection as it is of a porous nature, can be produced in varying porosities, is not affected by petroleum products and is resistant to the action of water in the quantities usually found in petroleum products. When such type of paper is employed in a single thickness, it is preferably employed in thicknesses ranging from forty thousandths of an inch to eighty thousandths of an inch when employed for filtering the lubricating oil of an internal combustion engine, for instance. Other grades and types of paper may, of course, be employed when capable of meeting the conditions above set forth and, of course, the thickness thereof may vary to a greater or lesser extent from the thicknesses above given depending upon the particular characteristics of such other paper, depending upon the particular material to be filtered thereby, and also depending upon the pressures or other conditions met with in operation.

In assembling the filter pack 10 in accordance with the present invention a dummy tube or pilot rod is used. This dummy tube or pilot rod is of a diameter to be relatively closely but slidably received in the central openings 54 of the filter discs 50 and the inner annuli 56 of the intercalary members 52. In such case one of the end members 46 is first applied to the tube, it is then followed by one of the intercalary members 52, for instance, as a matter of illustration, one of such intercalary members having the ports 62 in the outer annulus 58 thereof, then followed by a filter disc or member 50, then followed by another intercalary member 52 but this time one of which has ports 64 in the inner annulus 56 thereof, this being followed by another filtering disc 50, and this sequence of parts applied to the tube repeated until the desired axial length of the filter pack has been reached, after which the opposite end member 46 is applied.

The pack thus assembled is then preferably compressed axially to a slight extent and is then secured together as a unit. This latter may be accomplished by suitable binding tapes extending axially of the pack from one end member 46 to the opposite end thereof as, for instance, as illustrated in the Colas patent above identified, but preferably and in accordance with a further phase of the present invention I prefer to apply a coating of material to the exterior surface of the filter pack which when dry will serve to maintain the various members or elements of the pack in assembled relation and at the same time will impart a more finished appearance to it. Such material may be applied in the same manner as any other coating, that is by brush, spraying or the like. Where the filter is to be employed for filtering petroleum products it may consist of shellac, suitable artificial enamels such as now are generally found upon the market, or other suitable or equivalent material. While such material itself is impervious to the passage of the liquid to be filtered therethrough, nevertheless the ports 62 in alternate intercalary members 52 will permit the passage of the liquid to the spaces or pockets between the filtering discs 50 and thus have no adverse effect on the efficiency of the filter pack.

In Figs. 3, 4 and 5 a modified method of forming a filter pack such as 10 is illustrated and this constitutes a further phase of the present invention. The parts shown in Figs. 3, 4 and 5 are indicated by the same numerals as are employed in Figs. 1 and 2 except that such numerals bear a prime mark. Consequently it is not necessary

to go into full detail with respect to the construction of each of the various elements but simply to point out the differences existing in the two constructions. As illustrated in Figs. 3, 4 and 5 a plurality of the members 50 and 52 are formed from a single sheet or strip of material and in stamping them out or otherwise forming them they are not completely severed from each other but instead each member is connected to its adjacent member over a short length of the material between them, for instance as illustrated at *a* in Fig. 3. The centers of the members 50 and 52 are preferably located in line with each other as shown. In forming up the strip illustrated in Fig. 3 the members 50', of course, alternate with the members 52' and alternate members 52' are, of course, alternately broken or ported as at 64' through their central annulus 56' and through their outer annulus 58' as at 52', respectively. The line of connection *a* between alternate members 50' and 52' are preferably scored, as indicated at 70 in Fig. 4, in a direction perpendicular to the line connecting the centers of the various members and preferably, as illustrated in Fig. 4, alternately on opposite sides of the strip formed by such members. In this manner the lines of connection *a* serve as alternately foldable hinges connecting these members so that they may be readily folded accordionwise as illustrated in Fig. 5 to bring them into the same stacked relation as the equivalent members in Fig. 1. Instead of the scoring, but preferably in addition thereto, the material may be pierced or perforated as indicated at a plurality of closely adjacent points over each line of connection *a* so as to further weaken the material along such line to further assure the bending of the material along such line in the folding operation. While it may, of course, be preferable that the length of the strip illustrated in Fig. 3 be sufficiently long to include all of the elements required for one complete filter pack such as the pack 10 illustrated in Fig. 1, this is, of course, not necessary in all cases as a sufficient number of shorter strips may be folded up and applied together to obtain a filter pack of the desired axial length.

It will, of course, be appreciated that the construction illustrated in Figs. 3, 4 and 5 eliminates a great deal of the work required in assembling the construction illustrated in Fig. 2, the spokes 60 in alternate members 52' being automatically located in crossed relation with respect to each other and being so located in the original strip, thus requiring no care on the part of the operator to so position them in assembly of the pack. It also eliminates the need of employing the dummy or pilot rod in assembling the pack. While in the completed pack the adjacent members 50 and 52 will be connected together, and throughout the entire filter pack when made up from a single strip such as illustrated in Fig. 3, this is an advantage rather than a disadvantage inasmuch as it aids the adhesive coating applied to the final product in holding the pack in assembled relationship. The material from which the elements or members 50' and 52' in Fig. 3 are constructed from may, of course, be the same or equivalent to the material from which the elements 50 and 52 previously described are constructed from.

Having thus described my invention what I claim by Letters Patent is:

1. In the manufacture of a filter pack formed from alternate filtering members of one forma-

tion and intercalary members of a different formation arranged in stacked relation, the steps of cutting a strip of filtering material of uniform width to form a strip comprising said filtering members each having a central tube receiving aperture and said intercalary members each comprising a frame-like structure in alternating relationship and integrally connected to one another along a line of limited length, then folding said strip of alternating filtering and intercalary members on said lines in accordion-like relationship to bring them into face to face and contacting relationship, and securing them in such relationship.

2. In the manufacture of a filter pack formed from alternate filtering members of one formation and intercalary members of a different formation arranged in stacked relation, the steps of cutting a strip of filtering material of uniform width to form a strip comprising said filtering members each having a central tube receiving aperture and said intercalary members each comprising a frame-like structure in alternating relationship and integrally connected to one another along a line of limited length, scoring said strip along said lines alternately on opposite sides of said strip over the length thereof, folding said strip on said lines alternately in opposite directions to bring said members into face to face and contacting relationship, and then securing said members against separation.

3. The method of forming a filter pack of the annular type consisting of centrally apertured filtering members and alternate intercalary members wherein the intercalary members consist of inner and outer annuli connected together by a pair of diametrically arranged spokes, the steps of operating upon a strip of filtering material to alternately form said filtering members and said intercalary members each connected to the next by an unsevered portion of said material, with the spokes in alternate intercalary members in transverse relation with respect to the remaining intercalary members, and with breaks in the inner annuli of alternate intercalary members and in the outer annuli of the remaining of said intercalary members, then folding said strips about the unsevered lines of connections between said members accordionwise whereby to bring said members into face to face and contacting relation with respect to each other, and securing said members together.

4. In the manufacture of a filter pack formed from alternate filtering members of one formation and intercalary members of a different formation arranged in stacked relation, the steps of cutting a strip of filtering material of uniform width to form a strip comprising said filtering members each having a central tube receiving aperture and said intercalary members each comprising a frame-like structure in alternating relationship and integrally connected to one another along a line of limited length, perforating said strip on said lines, folding said strip on said lines alternately in opposite directions to bring said members into face to face and contacting relationship, and then securing said members against separation.

5. In the manufacture of a filter pack formed from alternate filtering members of one formation and intercalary members of a different for-

mation arranged in stacked relation, the steps of cutting a strip of filtering material of uniform width to form a strip comprising said filtering members each having a central tube receiving aperture and said intercalary members each comprising a frame-like structure in alternating relationship and integrally connected to one another along a line of limited length, scoring said strip along said lines alternately on opposite sides of said strip over the length thereof, perforating said strip on said lines, folding said strip on said lines alternately in opposite directions to bring said members into face to face and contacting relationship, and then securing said members against separation.

6. In the manufacture of a filter pack comprising a stack consisting of a plurality of filter members and a plurality of intercalary members of substantially the same external contour, with the filter members separated from each other by intercalary members, and with each of said members arranged in flat contacting relationship with respect to the next adjacent members, the steps of cutting a strip of filtering material to form a one-piece strip comprising a plurality of said filter members each of sheet-like form with a central tube receiving aperture and a plurality of said intercalary members each of frame-like structure with the major portion of its central area removed with each of said filter members bounded at each edge thereof in the length of the strip by an intercalary member integrally connected thereto, scoring the line of connection between said members with the score between each member and the member next adjacent thereto on one side thereof on one side of said strip and with the score between it and the other member next adjacent thereto on the other side of said strip, then folding said members accordionwise on said lines of fold to bring each member into aligned and flat contacting relationship with the members next adjacent thereto to form a stack, and then permanently securing all of said members in said stack together.

7. In the manufacture of a filter pack comprising a stack consisting of a plurality of filter members and a plurality of intercalary members of substantially the same external contour arranged in flat contacting relationship and with each adjacent pair of filter members separated by at least one intercalary member, the steps of cutting a strip of filtering material to form a one-piece strip comprising a line of said filter members each of sheet-like form having a single central tube receiving aperture each of which is separated from the next adjacent filter member by at least one intercalary member each comprising a relatively narrow perimetrically extending band and with said filter members and said intercalary members in said strip integrally connected together by a line of fold extending transversely of the length of said strip, then folding said strip accordionwise on said lines of fold to bring each of said members into flat contacting and aligned relationship with respect to the next adjacent members connected thereto in said strip to form a stack, and then permanently securing all of said members together in said stacked relation.

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