

March 23, 1954

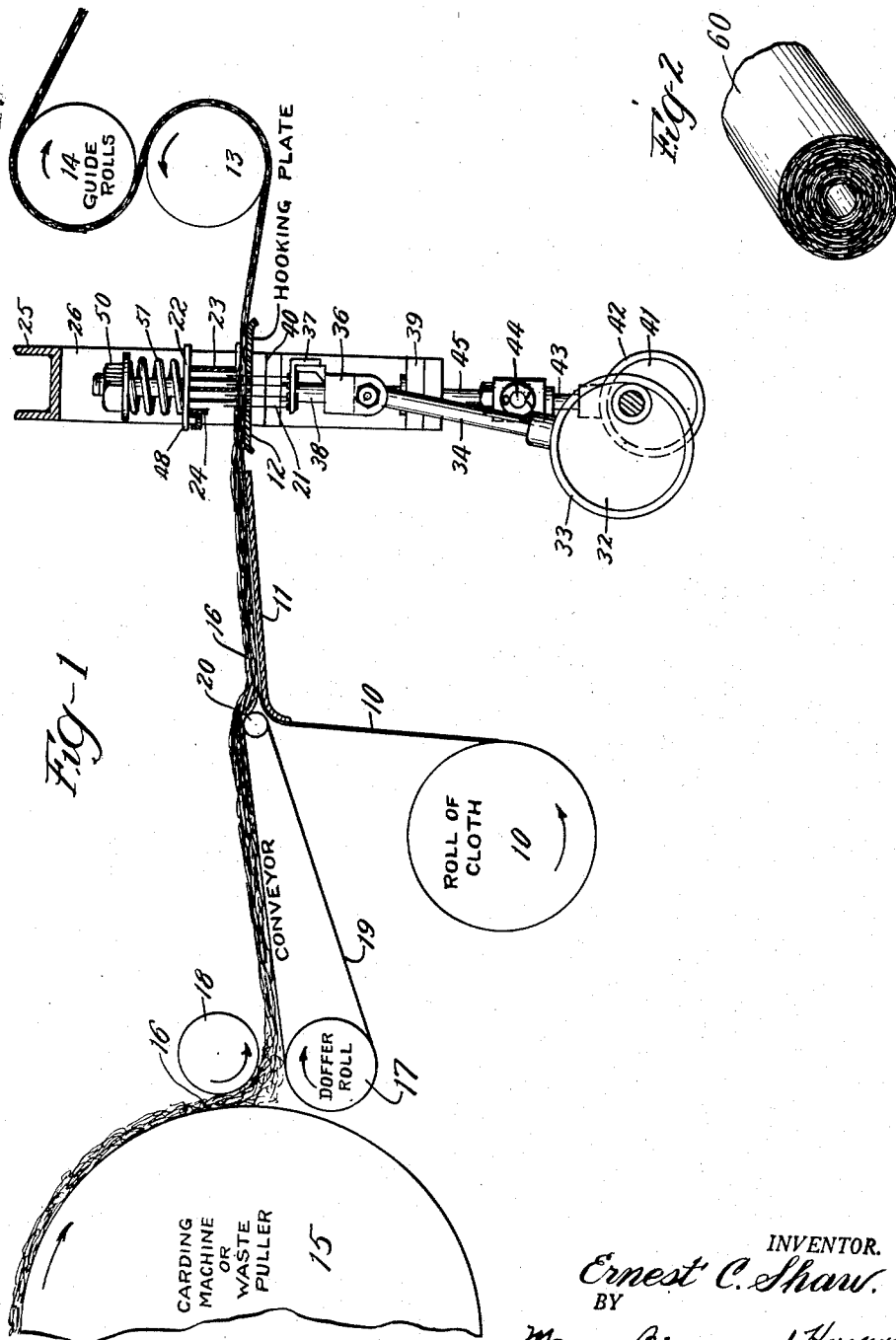
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2,672,673

MANUFACTURE OF FIBROUS MATERIAL FOR FILTERS AND THE LIKE

Filed Feb. 10, 1951

4 Sheets-Sheet 1



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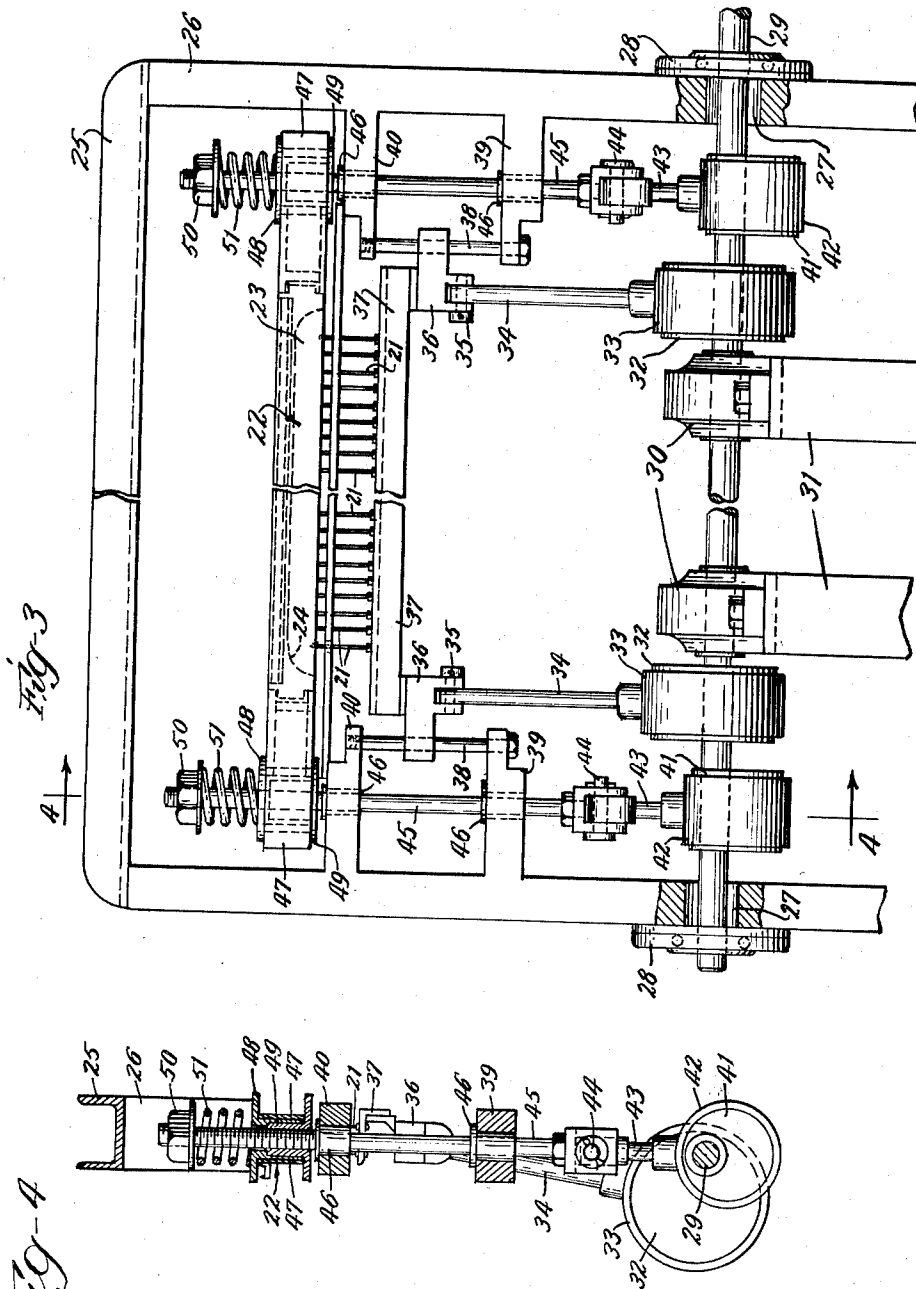
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MANUFACTURE OF FIBROUS MATERIAL FOR FILTERS AND THE LIKE

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4 Sheets-Sheet 2



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MANUFACTURE OF FIBROUS MATERIAL FOR FILTERS AND THE LIKE

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4 Sheets-Sheet 3

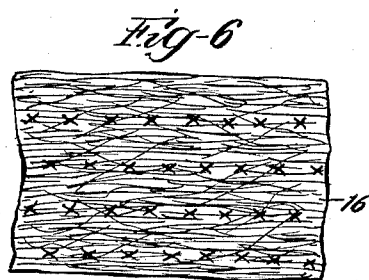
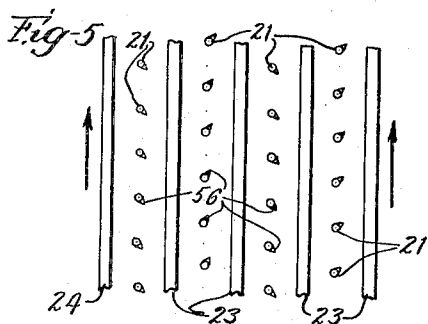
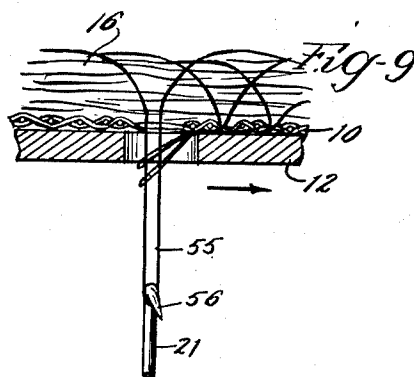
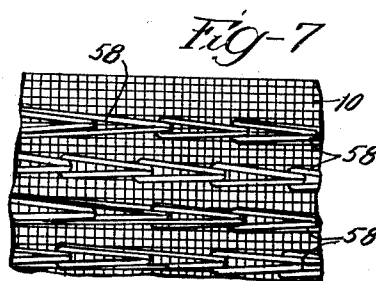
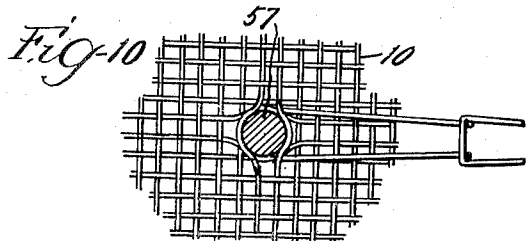
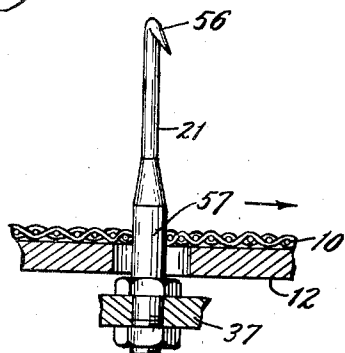


Fig-8



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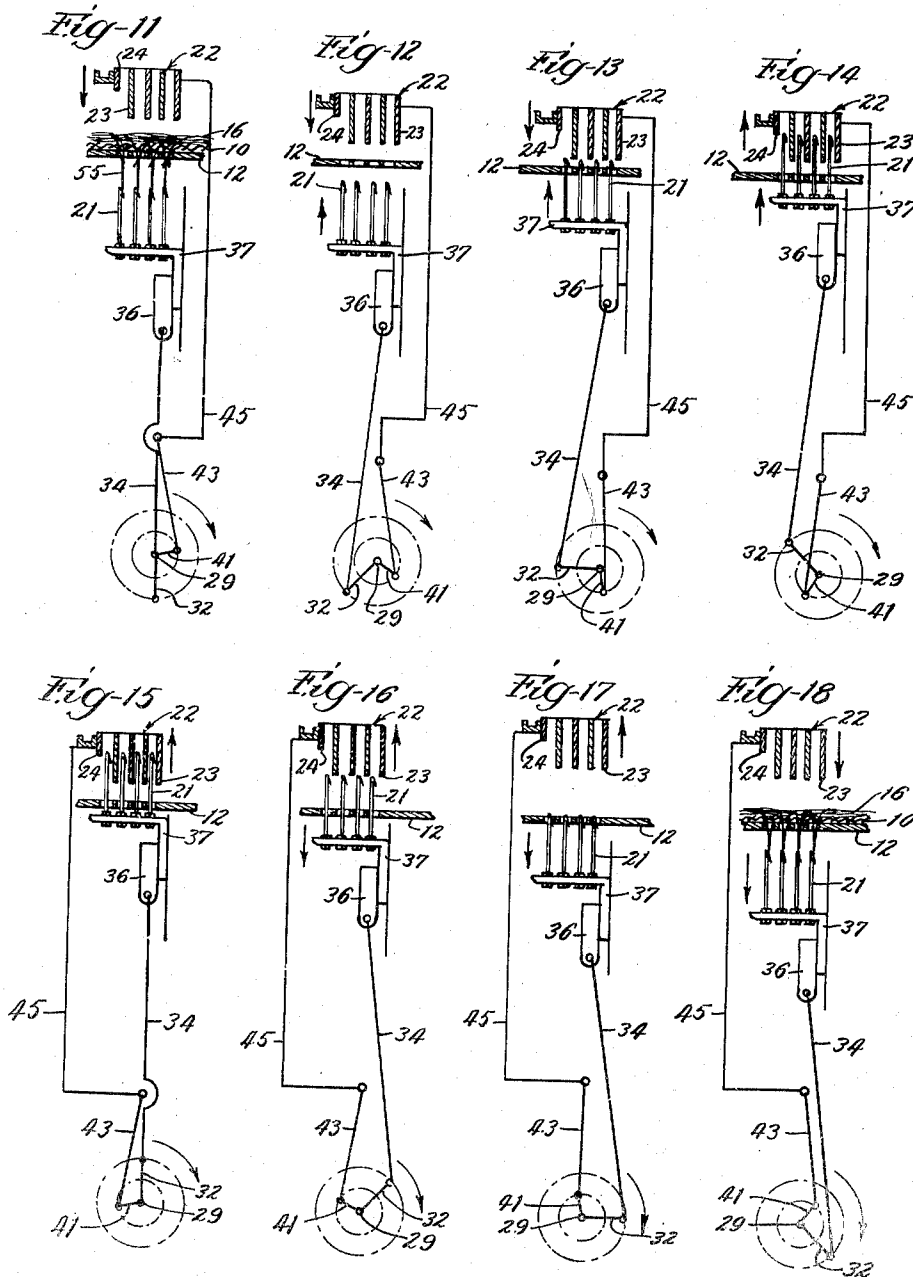
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MANUFACTURE OF FIBROUS MATERIAL FOR FILTERS AND THE LIKE

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4 Sheets-Sheet 4



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MANUFACTURE OF FIBROUS MATERIAL FOR
FILTERS AND THE LIKE

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10 Claims. (Cl. 28—4)

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The principal defect in filters made of waste is their lack of uniform density throughout which results in "channeling" along paths of relatively low obstruction to flow or lighter density. That means that the filtering is actually done by the channeling passages instead of by the whole filter. This difficulty is the unavoidable result of packing filter casings by hand with bulk waste which always lacks uniformity.

The principal object of this invention is to provide filters and filter material of practically uniform thickness and density throughout crosswise to the flow of oil to be filtered.

Generally speaking, this is accomplished by laying a uniform sheet or layer of carded waste with the threads for the most part running lengthwise to the sheet feeding it and a loosely woven fabric one upon the other, hooking threads of the waste through the fabric so as to form loops and which interlace the two together.

When that material is rolled lengthwise to form a filter cartridge, it is practically uniform throughout, with most of the threads running circumferentially with respect to the filter cartridge. That gives faster, uniform flow and longer life with less material than customary because of the even distribution. The complete uniformity appears when such a filter cartridge is unrolled after a normal period of use and shows a uniform color throughout.

When waste is compacted under pressure, it becomes impenetrable to needles, and even the pressure of inserting a hooked needle will often shift it out of place. On this account, making the laminated sheet of waste and woven fabric uniform is best done by a new process with a new machine which promotes the hooking of the threads and the interlacing of the waste and fabric together.

In the drawings—

Fig. 1 is a diagram illustrating the essentials of the machine and the steps of the process embodying the invention;

Fig. 2 is a diagrammatic representation of a filter cartridge made by rolling up a sheet or strip of the basic material;

Fig. 3 is an end view of the machine embodying the invention, parts being broken away to reveal the inside of the frame;

Fig. 4 is a vertical section on the line 4—4 of Fig. 3;

Fig. 5 is a diagrammatic layout of rows of hooking needles and controller bars in the general relation they have in plan;

Fig. 6 is a plan view of a sheet made by the operation of Fig. 1 looking at the upper side;

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Fig. 7 is a similar view looking at the lower side;

Fig. 8 is an enlarged fragment showing one hooked needle, a portion of the hooking plate and some material thereof;

Fig. 9 is a view somewhat similar to Fig. 8 showing the needle pulled through the layer of waste and fabric, and indicating a loop of waste thread drawn below the hooking plate;

Fig. 10 is a plan view looking downwardly on Fig. 8 and indicating how the needle opens up the fabric, to the end that, as the needle moves from the position shown in Fig. 8 to that shown in Fig. 9, it will taken a thread or threads of waste through an opening in the fabric without catching the fabric; and

Figs. 11 to 18 are diagrams showing selected positions of the parts of the machine during a cycle of operation.

In Fig. 1, 10 indicates a roll of loosely woven fabric such as cheesecloth, adapted to be drawn over a guide 11 across a hooking plate 12 and about guide rolls 13 and 14, from which it is delivered to a winder or trimmer or some other machine.

15 indicates a carding machine or waste puller which delivers a sheet or layer of carded waste 16 by the action of a doffer roll 17 and a guide roll 18. The delivery is onto a conveyor belt 19 running over the doffer roll 17 and a small idler 20, which conveyor lays the sheet of waste 16 on the cheesecloth 10, and the two travel over the guide 11 and across the hooking plate 12. As they move along the hooking plate, hooked needles 21 pass upwardly and downwardly through the superimposed layers or sheets in order to hook threads of the waste downwardly through the cheese cloth and loop the two together.

During this operation, the waste is controlled by a controller 22 consisting of spaced bars 23 and 24 straddling the rows of needles 21, both of them lying crosswise to the path of movement of the material to be interlaced together.

The composite sheet or blanket thus made is passed through rolls 13 and 14 and either rolled up for storage or passed through a trimmer and then on to other operations.

The machine as shown in Fig. 3 includes a frame, generally indicated by 25, having upright, spaced sides 26 provided with openings 27 and adjacent thereto, with flange-type, outboard bearings 28 for a shaft 29 driven from a motor or other source of power through a variable speed drive such as a Reeves.

Between the side frames 26, the shaft 29 is

journalled in bearings 30 supported by pedestals 31.

Adjacent to the pedestals 31, the shaft 29 is equipped with ball-bearing eccentrics 32 having straps 33 fixed to connecting rods 34 pivoted at 35 to crosshead brackets 36 fastened to a metal bar 37 equipped with the rows of needles 21. The crosshead brackets 36 run on guide bars 38 carried by arms 39 and 40 on the side frames 26.

Between the eccentrics 32 and the side frames 26, the shaft 29 is equipped with ball-bearing eccentrics 41 having straps 42 affixed to connecting rods 43, pivoted at 44 to side rods 45 running through guides 46 and the brackets 39 and 40, and carrying at their upper ends the controller 22.

The end portions of the controller include side plates 47 depending from a top plate 48 and having sockets to receive flange nuts 49 threaded on to the upper portion of the side rods 45 which also receive nuts 50 to compress springs 51 against the top plate 48, provide a yielding connection between the side rods 45 and the controller to yield when suitable pressure restrains the downward movement of the controller.

In a machine that has been found satisfactory, the eccentrics 32 have a throw of two inches, while the eccentrics 41 have a throw of one inch and are set 100° behind the eccentrics 32, thereby giving the motions of the needles and the controller different amplitudes of harmonic motion and in what may be called different phase by virtue of the 100° lag of the eccentric.

Figs. 11 to 18 indicate one cycle of operations beginning with Fig. 11 and ending with Fig. 18. While the parts are going through these positions, the superimposed layers of cotton waste and loosely woven fabric are moving to the right along the course indicated in Fig. 1.

Fig. 11 shows the needles at their bottom position pulling loops 55 of waste thread through the fabric and extending a considerable distance below the hooking plate 12. The controller with its spaced bars is coming down as indicated by the arrow at the upper left. The four bars 23 are straddling rows of needles, and the short bar or narrow bar 24 is to the left of the first row of needles.

In Fig. 12, the needles are going up. They let the loops 55 slack and start a penetration of one or more loops previously made while the controller still comes down.

In Fig. 13, the needles have just penetrated the fabric, gone through the previous loops, and are attempting to penetrate the waste mass on the fabric. This action has raised the sheet slightly, tending to pull the waste away from the cloth, and would, if not restrained, destroy or pull out the loops. They are restrained by the action of the controller which at this point of the cycle has brought the bars in position to resist the upward movement of the waste sufficiently to protect the loops but free from such pressure as would prevent the needles from passing through the waste.

In Fig. 14, the controller has reached and passed its bottom position, which should not be lower than just enough to hold the waste sheet in position on the fabric. In this figure, the needles and the controller are both on the upward movement, but due to the difference in the eccentrics, they are moving at different speeds which have been selected to exercise appropriate restraint on the waste while the needles work their way between the threads and out through the top of the waste sheet.

In Fig. 15, the needles are at the top position and the controller is still going up.

In Fig. 16, the needles are starting to come down and the controller bars are still going up to give ample clearance to the loose waste material traveling to the right.

In Fig. 17, the needles are going down, drawing the loops through the composite sheet, and the controller is still going up.

In Fig. 18, the needles are drawing the loops down beneath the hooking plate 12, and the controller is descending to get in readiness to resist the displacement of the waste by the rising needle as the cycle runs over again.

It is not practical to fully illustrate the cycles of the needles and the controller and their relative speeds but Figs. 11 to 18 are deemed sufficient to indicate the basic relations to those who are aware of the varying speeds of harmonic motion and the differences of travel due to the differences in the throws of the eccentrics.

It is important that the hooks 56 on the needles be at an angle to the direction of travel of the woven material and the waste; and generally speaking, it will be preferable to have those hooks extend at an angle of 45 degrees to the direction of travel, as shown in Fig. 5, for that will insure engagement of the hooks with the threads of the waste even when those threads run substantially parallel as they do in the preferred embodiment of the invention. The angle should be toward and not contrary to the direction of travel.

The carding machine or waste puller delivers the waste threads running generally lengthwise to the travel of the sheet 16 in Fig. 1. On the bottom of the layer, they are practically straight and parallel. On the top they tend to resume the bends that have become set in the threads, but still they run generally lengthwise to the sheet, and they lie in position to be caught by the hooks 56 of the descending needles.

The number of threads to be pulled from the unwoven material through the fabric for fastening is a variable depending somewhat upon the extent of the fastening desired or required. In many instances, a single row of needles reciprocating at a reasonable speed will give sufficient fastening for quantity production. In others, more rows of needles may be advantageously used. As here shown, there are four rows of needles spaced $\frac{1}{8}$ " in the rows and $\frac{1}{2}$ " between rows. It has been found satisfactory in the manufacture of material for filter cartridges for lubricating oil to have each needle pass through the mass for each $\frac{1}{8}$ " to $\frac{1}{2}$ " of travel.

Of course, the number and arrangement of needles may be varied to suit conditions. The fastening may be increased toward the margin of the sheet to be formed, or toward the margin and along other lines, depending on how the sheet is to be cut and handled in making up filter cartridges and the like.

It is important that the waste threads be free to spread as the needle penetrates. The thin, spaced controller bars restrain undesirable upward movement but leave the threads otherwise free to spread apart and let the needles through. The bar 24 is made narrow to let the relatively thick layer of waste pass readily.

After fastening a layer of waste on a woven sheet, it may be turned over and another layer fastened to the opposite side, thus producing a three-layer sheet with the woven fabric in the middle and serving as a fastening for the unwoven material. This is especially good for journal

box packing, though it may be used to advantage in filter cartridges. There is an advantage in rolling some filter cartridges with the woven fabric inside and wound on the perforated outlet tube, where it forms a final strainer to catch loose threads or fiber, and saves a separate element in the operation.

In others, such as large filters for lubricating oil or fuel oil, there is an advantage in rolling the cartridge with the woven fabric outside, where it serves to confine the cartridge, but freely permits yield to pressure from the outside.

It is important to provide the body of the needle with a portion 57 (Figs. 8 and 10) relatively large for the purpose of spreading the threads of the woven material 10, and the enlargement may well be, as here shown, of greater radial dimensions than the bight of the hooks 56 so that the hooks will not catch threads of the woven material as they descend. The spreading of the threads of the fabric is temporary but sufficient.

The openings in the hooking bar 12 are relatively large as compared with the enlargements 57 of the needles, and the needles are sufficiently resilient to bend as the woven material passes on while they are in about the positions shown in Figs. 1, 14, 15 and 16.

In many instances, particularly with the arrangement shown in the drawings, the loops of waste overlap and virtually knit the unwoven waste to the woven fabric, an attempt to show which is made in Fig. 7 where the loops are indicated at 58. This is a decided advantage where the material is to be handled much, but it will be understood from the nature of threads that actual loops are not always produced and are not indispensable to all uses of the material, for short straight threads pulled through the woven fabric will inherently form a fastening.

The basic material produced by the process and apparatus here described may be used in sheets, rolls, piles, or folds, or other forms, depending on the nature of their use. One form to which it is especially adapted is the roll 60 in Fig. 2, forming a cartridge or filter for an oil filter. When the composite sheet is rolled to form a filter cartridge, it can be made denser or more compact at the outer side by increasing the tension as the roll builds up, or denser toward the interior by the reverse variation in tension. If the oil is to pass through the roll from the outer side, it is often best to have the tension decrease as the roll enlarges, so that the outer portion will be more pervious than the inner, and the solid material in the oil can penetrate a short distance, depending on its size, and increase the filtering ability of the material by building up a bed of extraneous solids to be removed from the oil.

It is also an important feature of the filter cartridge made of the basic material of this invention that the warp threads continually bind it circumferentially while the woof threads restrain its elongation lengthwise to the cartridge. Hence, the threads of woven material strongly tend to maintain the size and form of the roll cartridge, although it will allow the cartridge to yield from pressure of entering oil and expand back to its original, or substantially its original, condition after the pressure is relieved, thus giving the cartridge a sort of breathing action which serves to shed excess extraneous material from the outside.

In a filter cartridge made according to this

invention, the waste material is substantially uniform throughout, thereby presenting substantially uniform filtering throughout and avoiding the undesirable channeling that has been characteristic of waste filters in the past.

Such a filter cartridge lends itself to great uniformity in machine manufacture to the end that cartridges run in uniform size and present uniform filtering area throughout. It has been found that by using half the waste material ordinarily used in hand-packed waste filters, greater filtering capacity and longer useful life can be had. In instances, the increase is 100%. This is partly due to the fact that the waste is uniformly distributed and maintained uniformly distributed by being fastened to the fabric.

The basic material can also be formed into a flat filter suitable for incorporation in the side of an engine, such as an internal combustion engine, where it will be quickly heated—a practical impossibility with the filters embodying a separate container spaced from the jacket.

In the preferred embodiment of the invention, the woven material is what is known as cheesecloth, and the unwoven material is what is known as carded waste, for which the Association of American Railroads, Mechanical Division, Specifications, M-905-41, adopted 1928, revised 1934, 1941, for New Waste for Journal Box Packing will be found satisfactory, except that no slasher should be used for filtering oil.

However, for filtering lubricating oil, cotton waste alone will be preferred by many because it inhibits the passage of moisture and absorbs acids. In filtering fuel oil, wool waste will be preferred by many because it passes the moisture.

The invention may be used with unwoven material of great variety, including metal or artificial fibers, and natural vegetable and animal fibers.

This application is a continuation in part of Serial No. 119,602, October 15, 1949.

I claim:

1. In a machine for hooking threads from an unwoven mass through a woven fabric, means to feed a woven fabric and a layer of waste together along a course, a row of hooked needles, means to reciprocate the needles crosswise through the fabric and the waste, a controller bar opposed to the row of needles at a side thereof and bearing on the layer of waste, and means to withdraw the controller bar from the waste in timed relation to the movement of the needles more slowly than the advance of the needles.

2. In a machine for hooking threads from an unwoven mass through a woven fabric, means to feed a woven fabric and a layer of waste together along a course, a row of hooked needles, means to reciprocate the needles crosswise through the fabric and the waste, a controller bar opposed to the rows of needles at a side thereof and bearing on the layer of waste, and means to reciprocate the controller bar toward and away from the waste simultaneously with the movement of the needles but on a cycle out of phase with the cycle of the needles so that the bar continues to move away from the waste after the needles begin their withdrawal movement from the fabric and waste.

3. In a machine for hooking threads from an unwoven mass through a woven fabric, means to feed a woven fabric and a layer of waste together along a course, a row of hooked needles, spaced controller bars opposed to the row of needles at each side thereof, means to reciprocate the needles crosswise through the fabric and waste and to reciprocate the bars simultaneously cross-

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wise to the course of fabric and waste with the cycle of the bars out of phase with that of the needles, said last named means including a shaft and means driven by the shaft with different strokes for the needles and the bars.

4. In a machine for hooking threads from an unwoven mass through a woven fabric, means to feed a woven fabric and a layer of waste together along a course, a row of hooked needles, spaced controller bars opposed to the row of needles at each side thereof, means to reciprocate the needles crosswise through the fabric and waste and to reciprocate the bars simultaneously crosswise to the course of fabric and waste with the cycle of the bars out of phase with that of the needles, said last named means including a shaft and harmonic motion devices driven by the shaft with one trailing behind the other in cycle.

5. The process which includes feeding a layer of waste and woven fabric one upon the other, reciprocating hooked needles through them to pull loops of threads of the waste through the fabric and controlling the relative movement of the waste and the fabric by applying yielding pressure to the waste opposite the points of penetration by the needles as the needles penetrate the waste.

6. The process which includes feeding a layer of waste and woven fabric one upon the other, reciprocating hooked needles through them to pull loops of threads of the waste through the fabric and restraining separation of the waste and the fabric as the needles penetrate the waste by applying holding means to the waste and withdrawing said means at a rate slower than the rate of advance of the needles.

7. The process which includes feeding a layer of waste and woven fabric one upon the other, reciprocating hooked needles through them to pull loops of threads of the waste through the fabric, and restraining separation of the waste from the fabric as the needles penetrate the waste by holding the waste down against the advancing needles by means moving in the same direction as the needles but at a slower rate of speed.

8. The process of making a filter cartridge or the like which includes interlocking a moving pair of superposed layers of fibrous thread waste and a relatively loosely woven fabric to form a composite sheet which comprises pulling hooked needles repeatedly through said moving layers to form a series of loops projecting from spaced openings in the fabric, the relationship

of the speed of movement of the layers and the speed of movement of the needles being such that on at least some of their movements the needles will enter the layers through previously formed loops and will pull new loops there-through

9. The process of making a filter cartridge or the like which includes interlocking superposed layers of fibrous thread waste and a relatively loosely woven fabric to form a composite sheet by pulling hooked needles through said layers to form loops projecting from openings in the fabric, moving said superposed layers transversely to the needles and simultaneously pushing the needles back into said layers through previously formed and projecting loops to pull new loops of thread from said layer of waste through said previously formed and projecting loops, and continuously repeating said operation to form a line of interlaced loops along the outer fabric surface of the composite sheet.

10. The process of making laminated filter material, journal box packing and the like, which includes feeding layers of loosely woven fabric and relatively thick, uniform, carded waste one upon the other, inserting hooked needles through the fabric and the waste while the waste is free to move and open up, pressing the waste over the needles and withdrawing the needles to hook threads of the waste and pull loops through the woven fabric, whereby the waste and fabric are interlaced.

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