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Fig. 1.

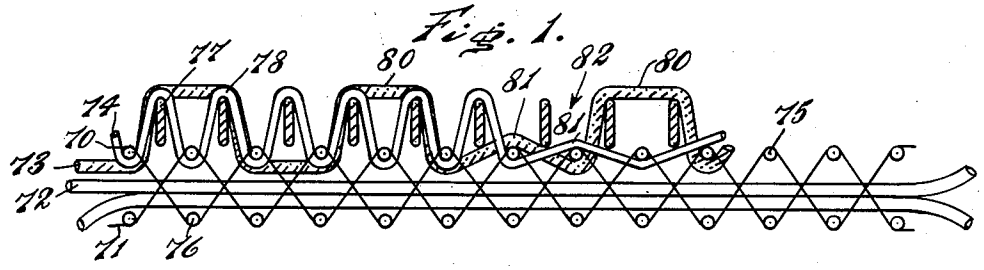


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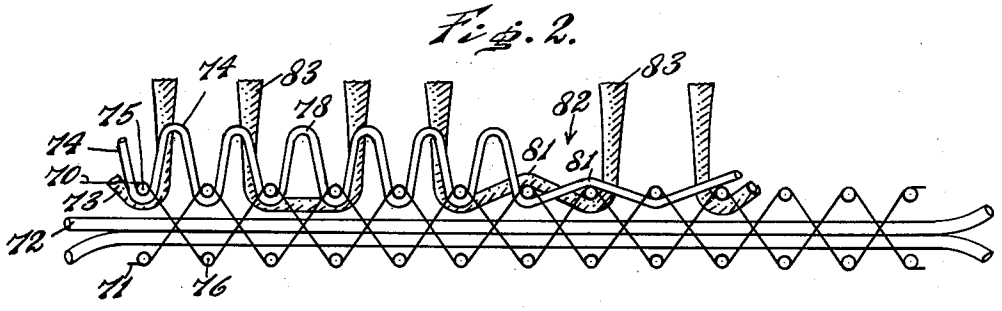


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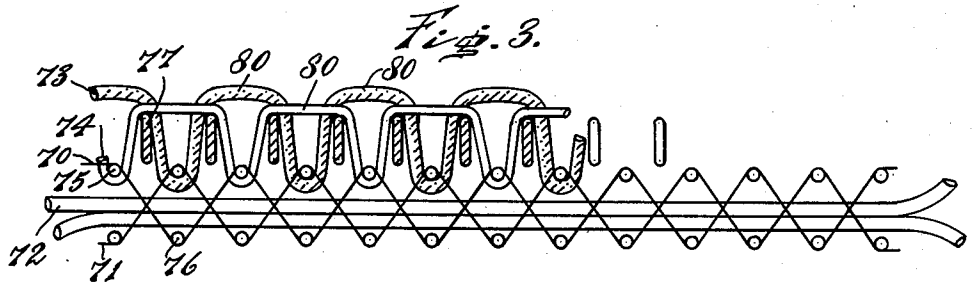
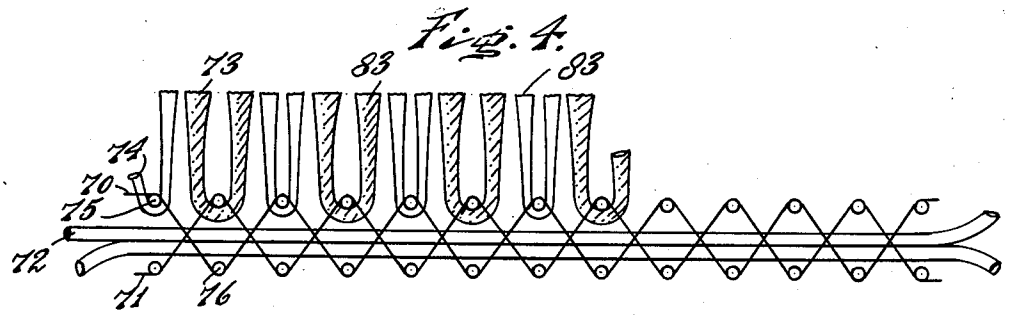


Fig. 4.



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Fig. 5.

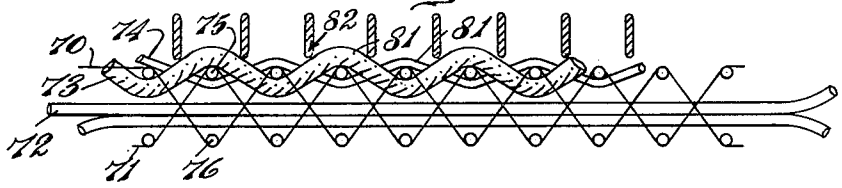


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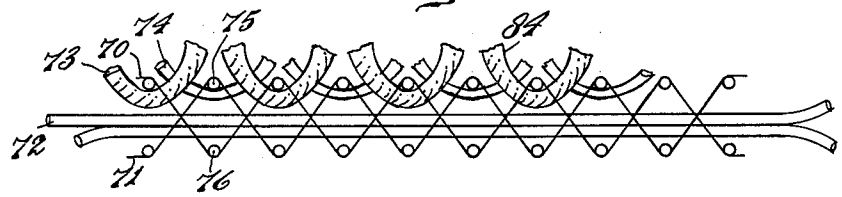


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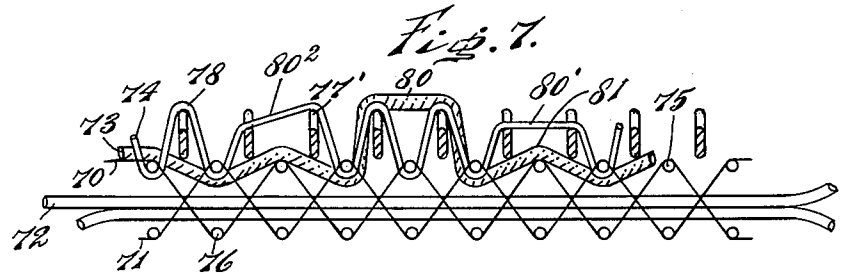
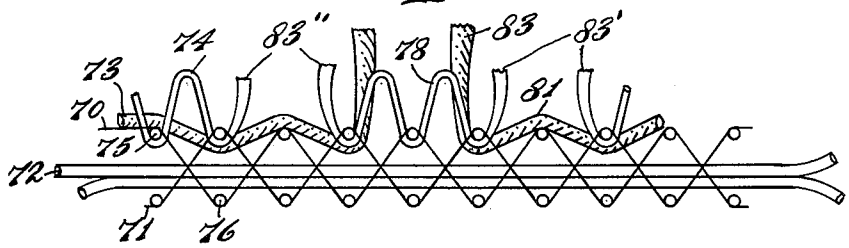


Fig. 8.



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Fig. 9.

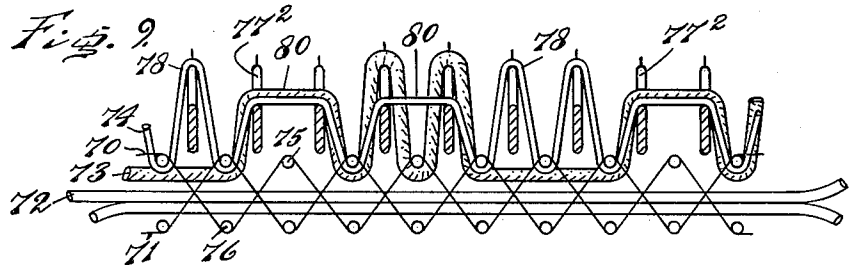


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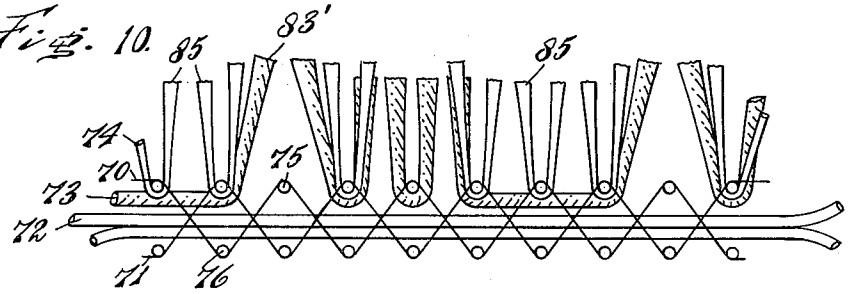


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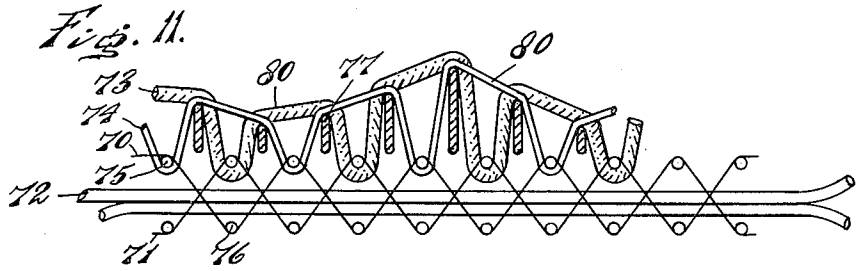
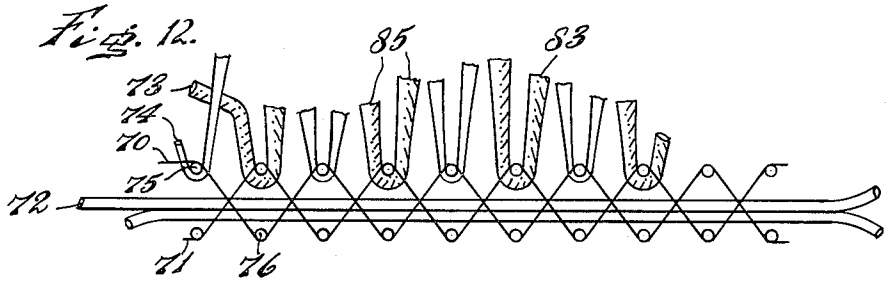


Fig. 12.



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Fig. 13.

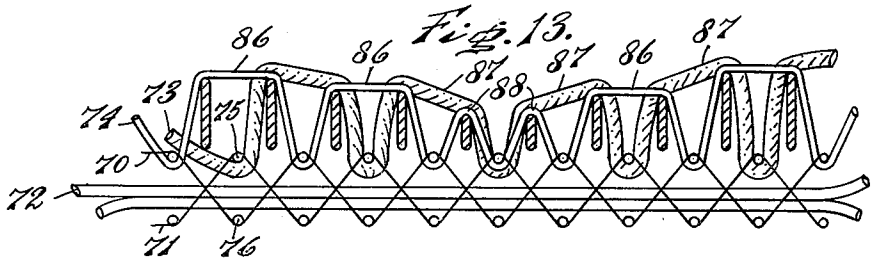


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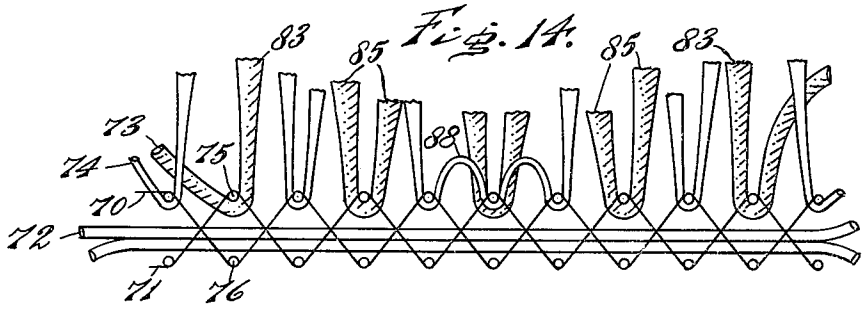


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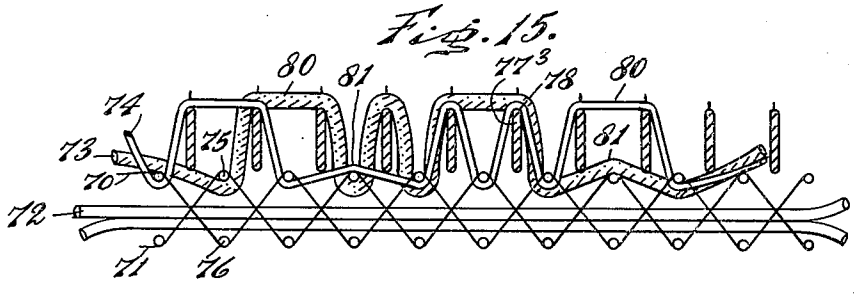
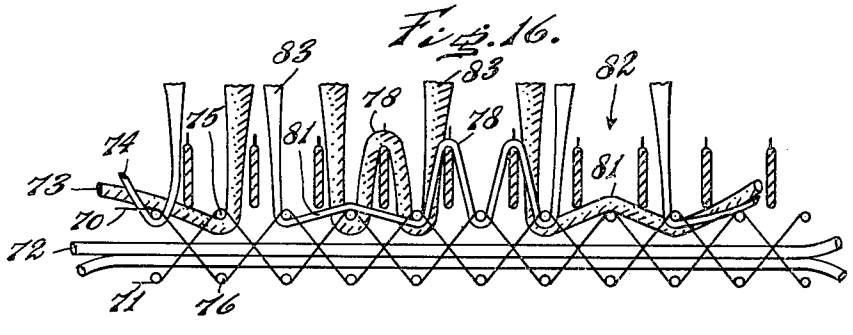


Fig. 16.



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Fig. 17.

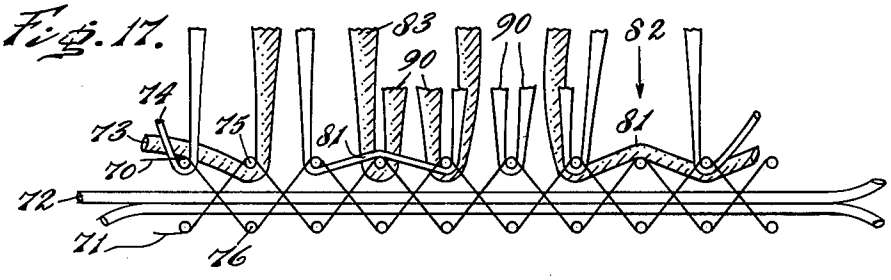


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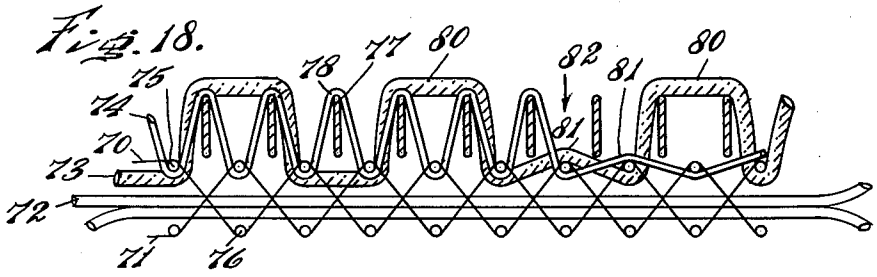


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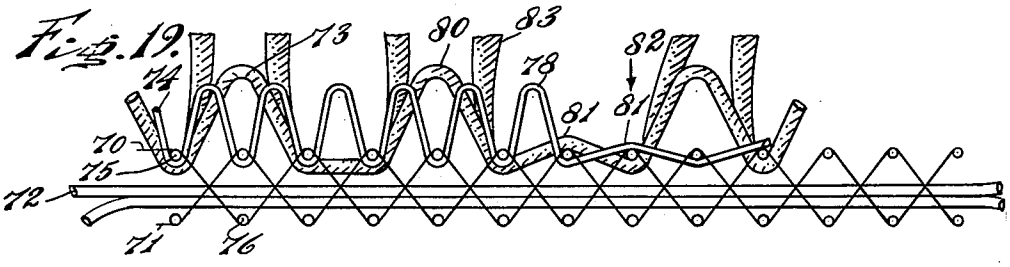
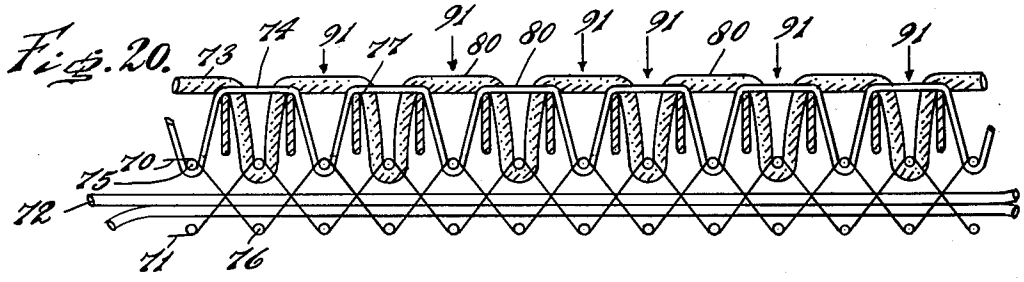


Fig. 20.



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Fig. 21.

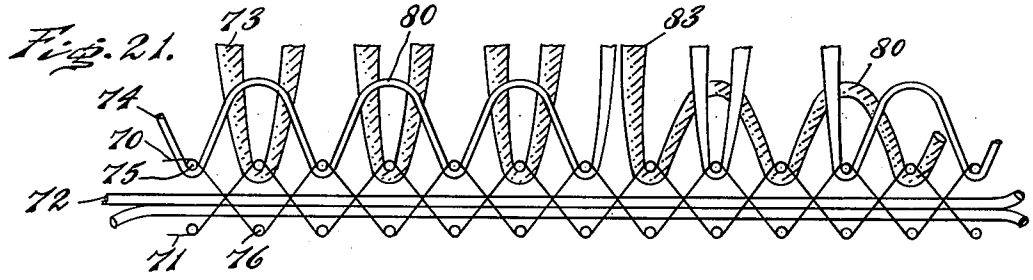


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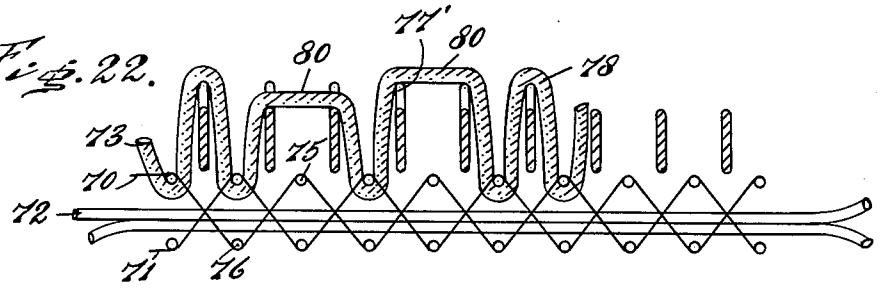


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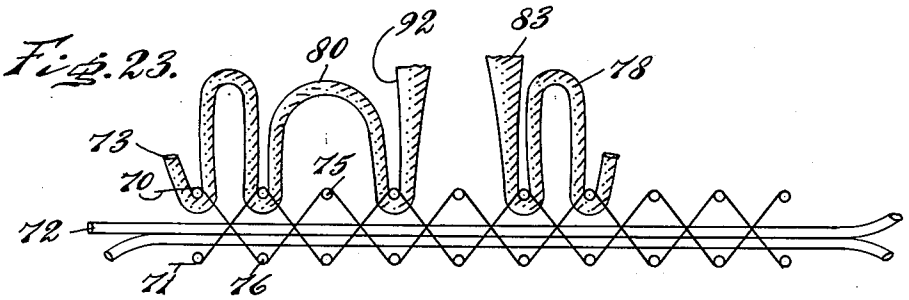
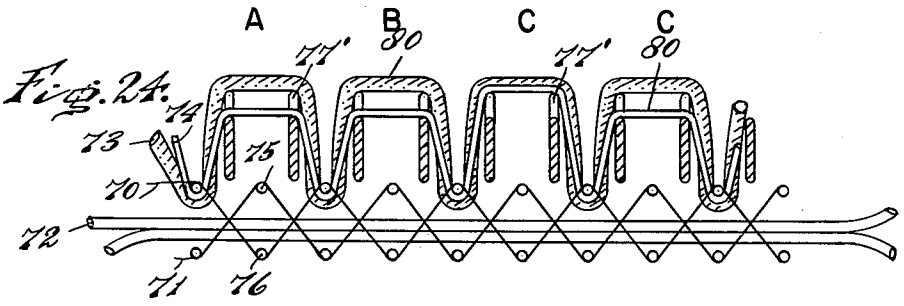


Fig. 24.



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Fig. 25.

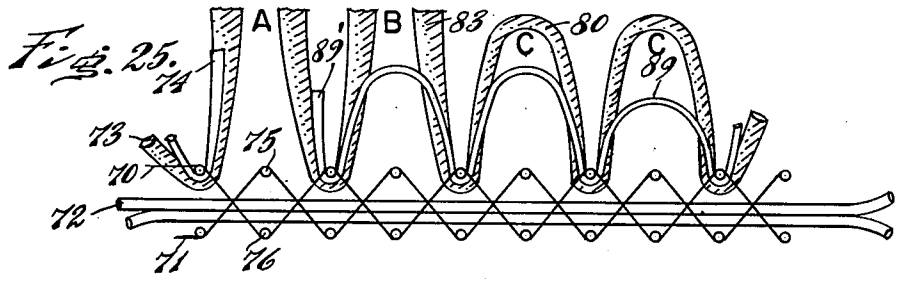


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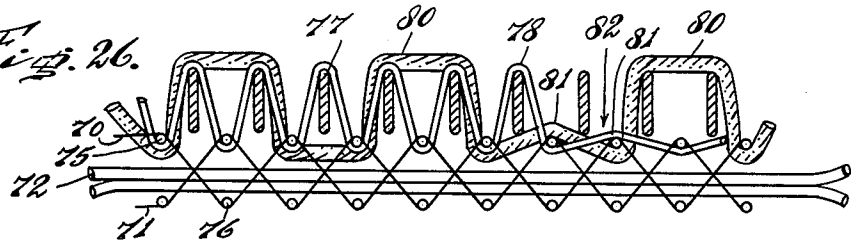


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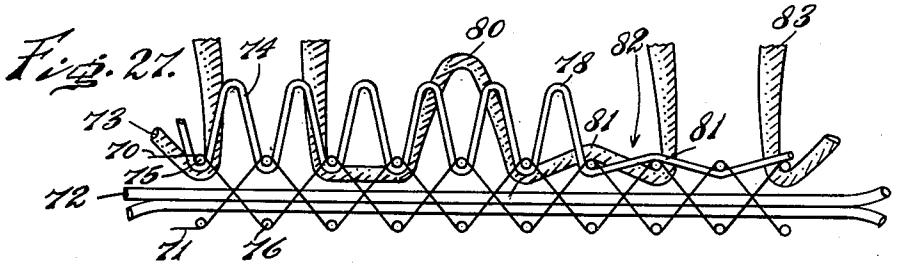
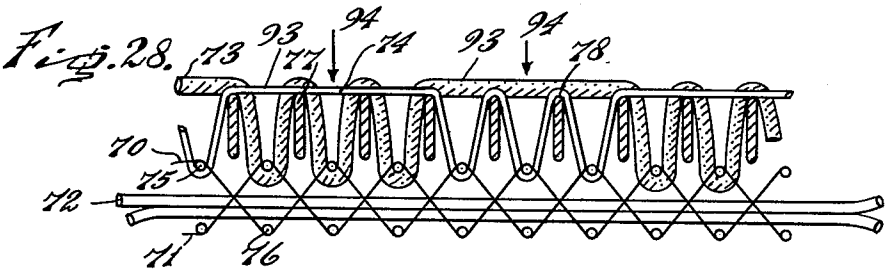


Fig. 28.



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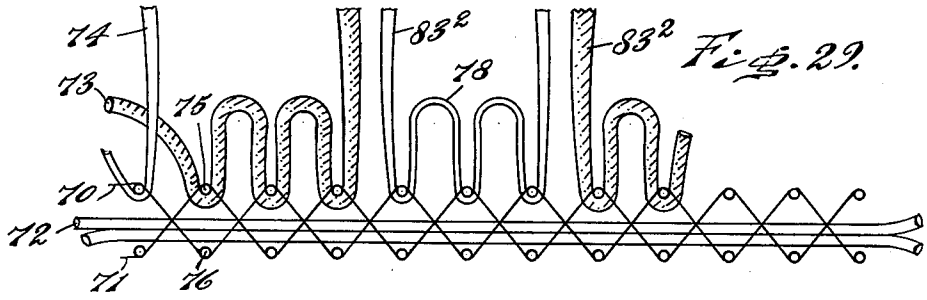


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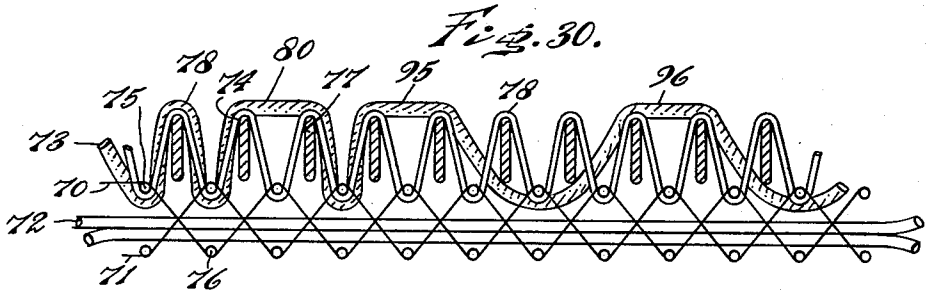


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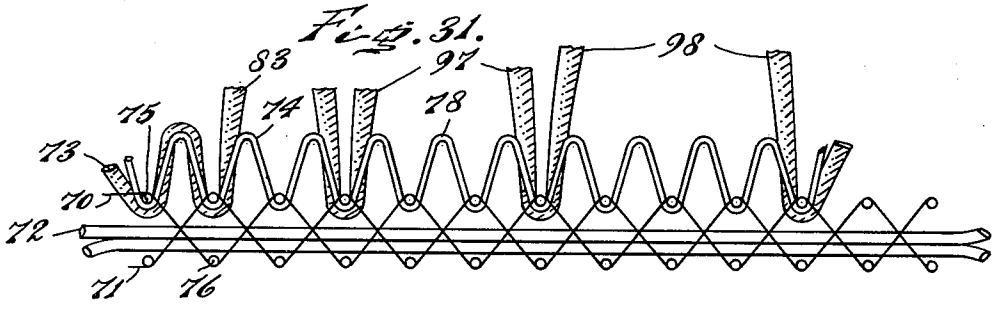


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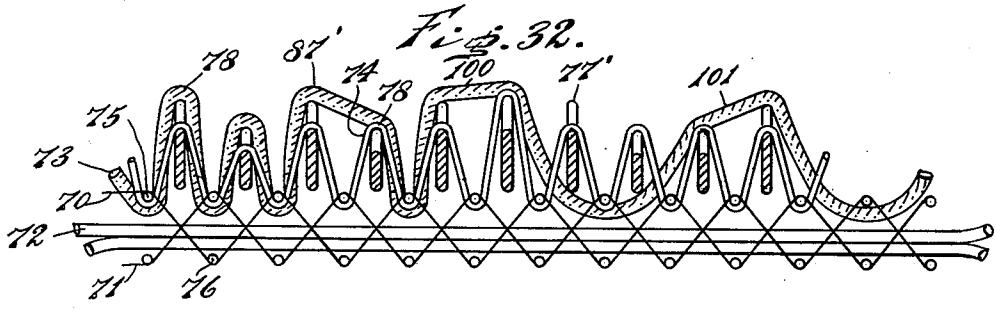


Fig. 32.

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Fig. 33.

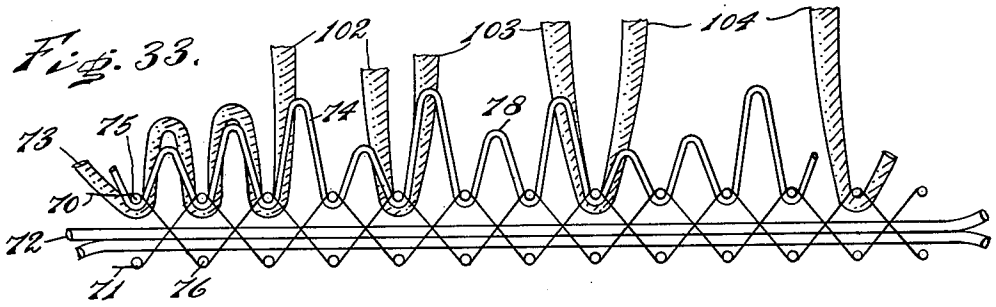


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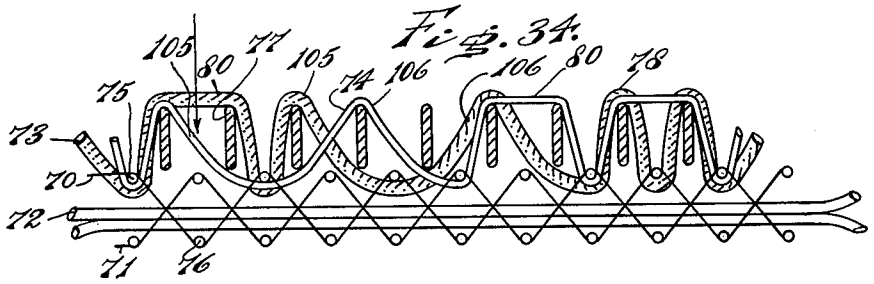


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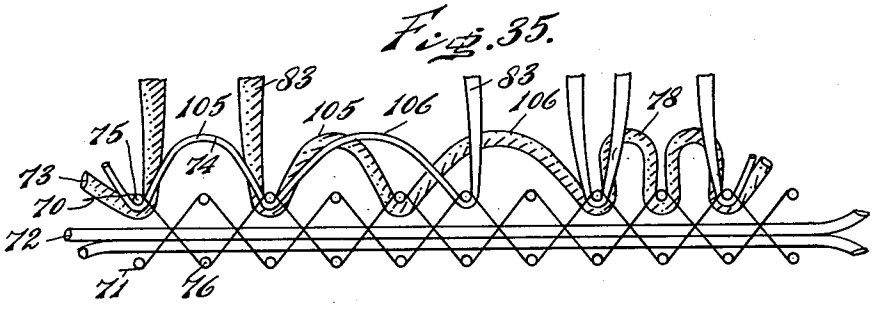
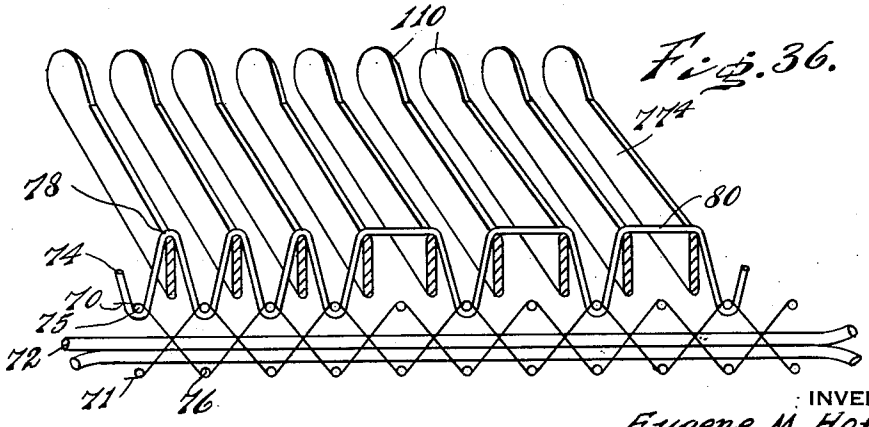


Fig. 36.



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Fig. 39.

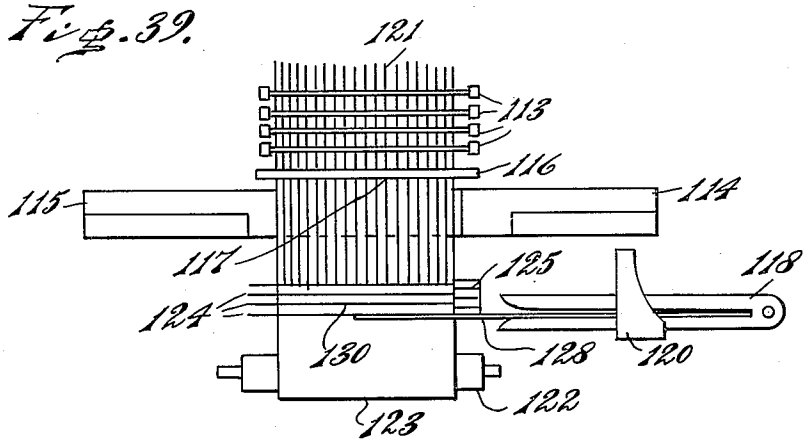


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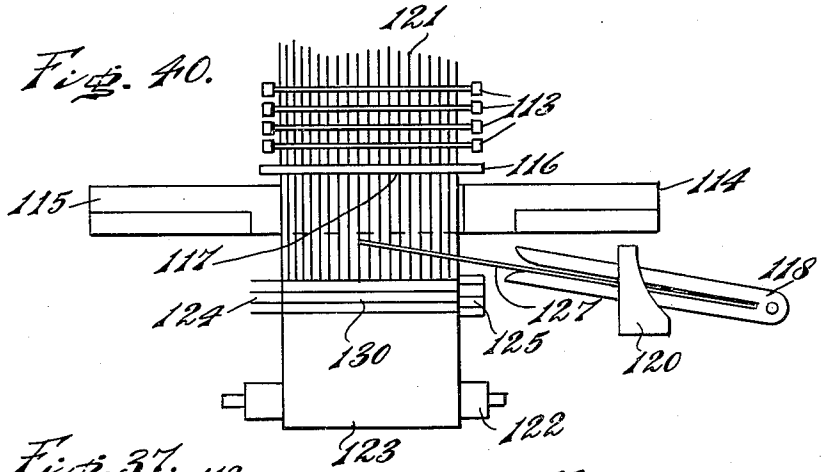


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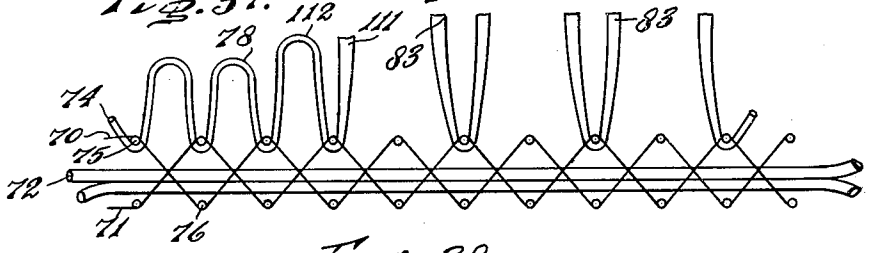
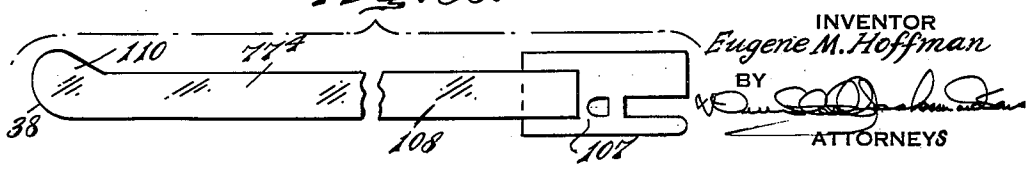


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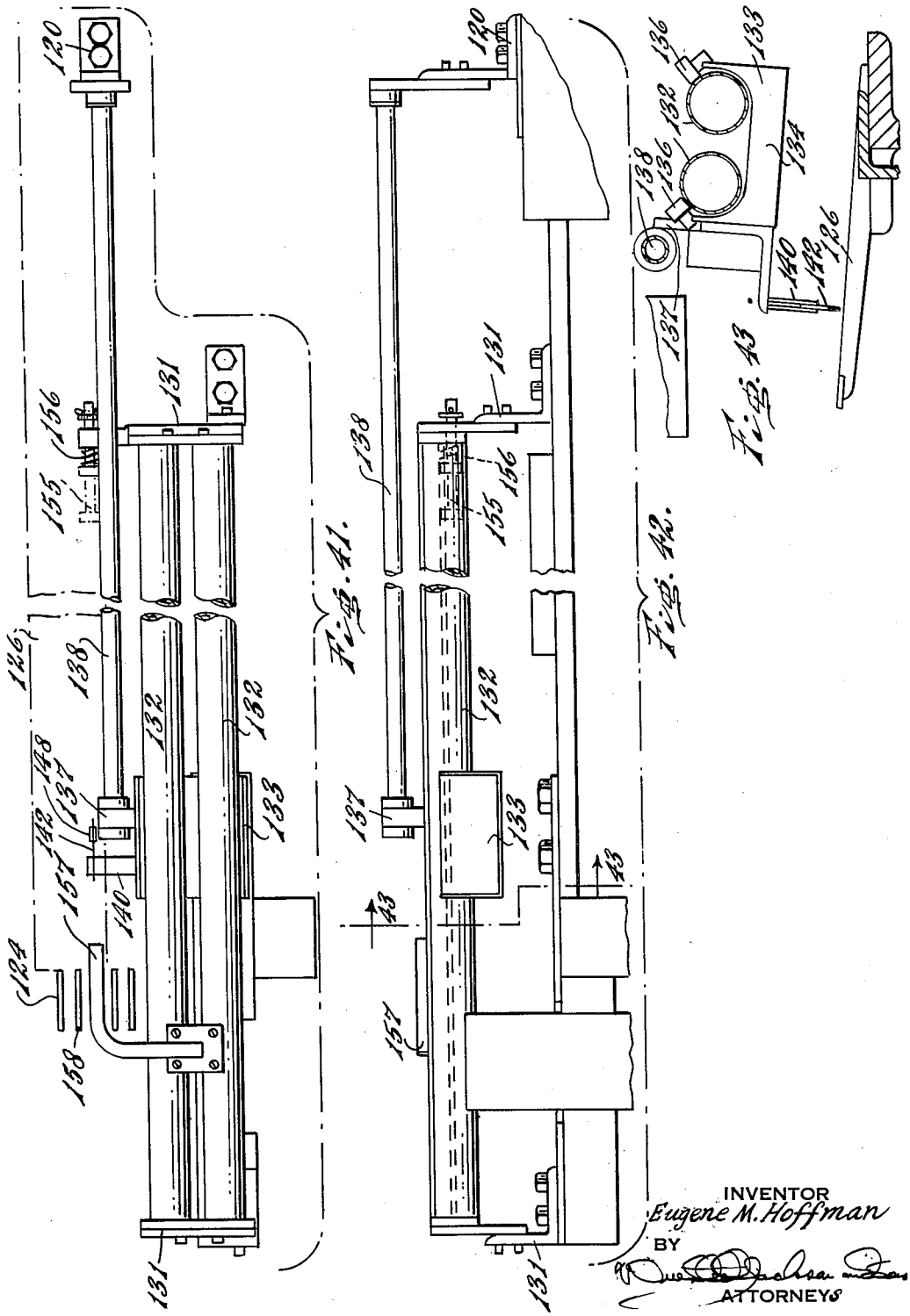


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Fig. 44.

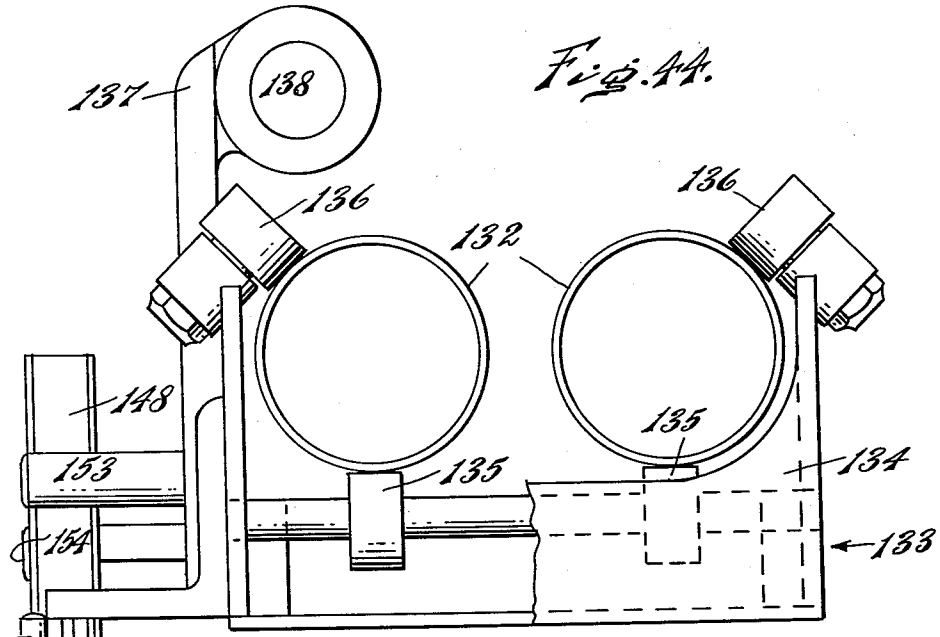
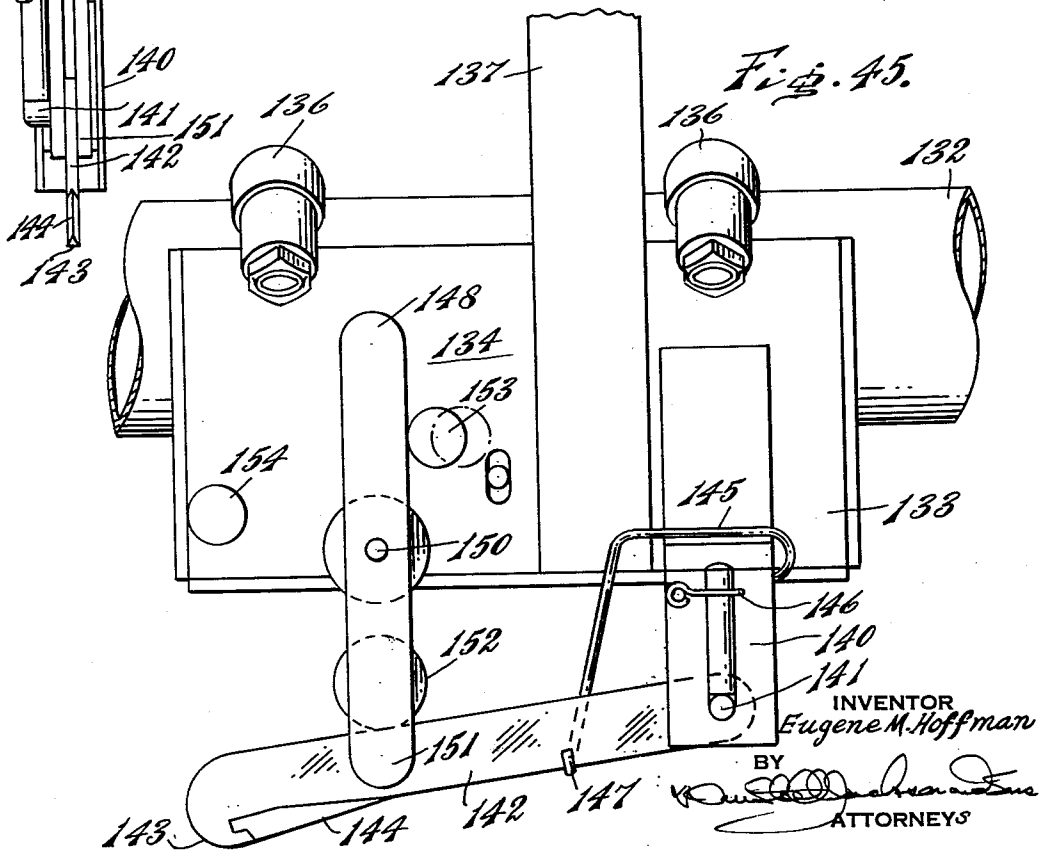


Fig. 45.



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Fig. 45a.

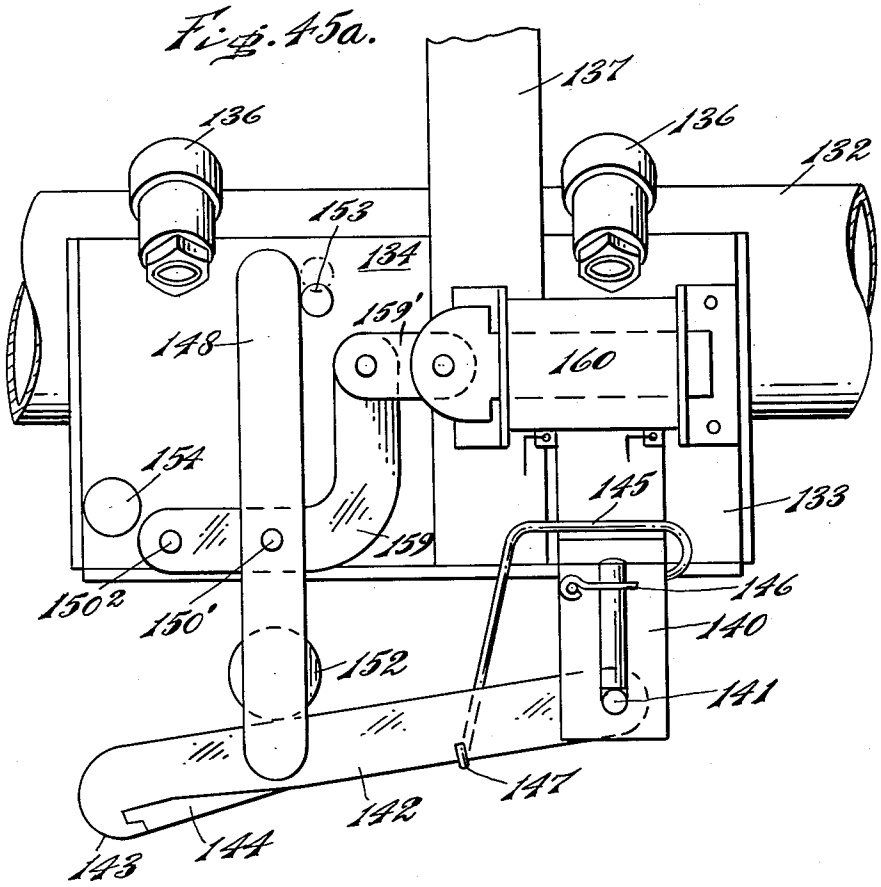


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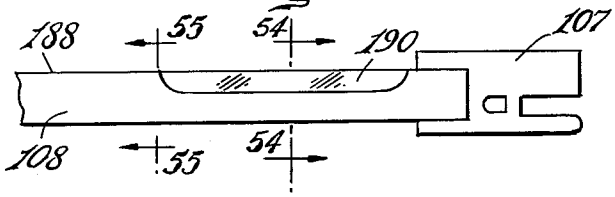


Fig. 55.

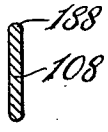
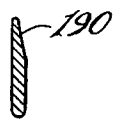


Fig. 54.



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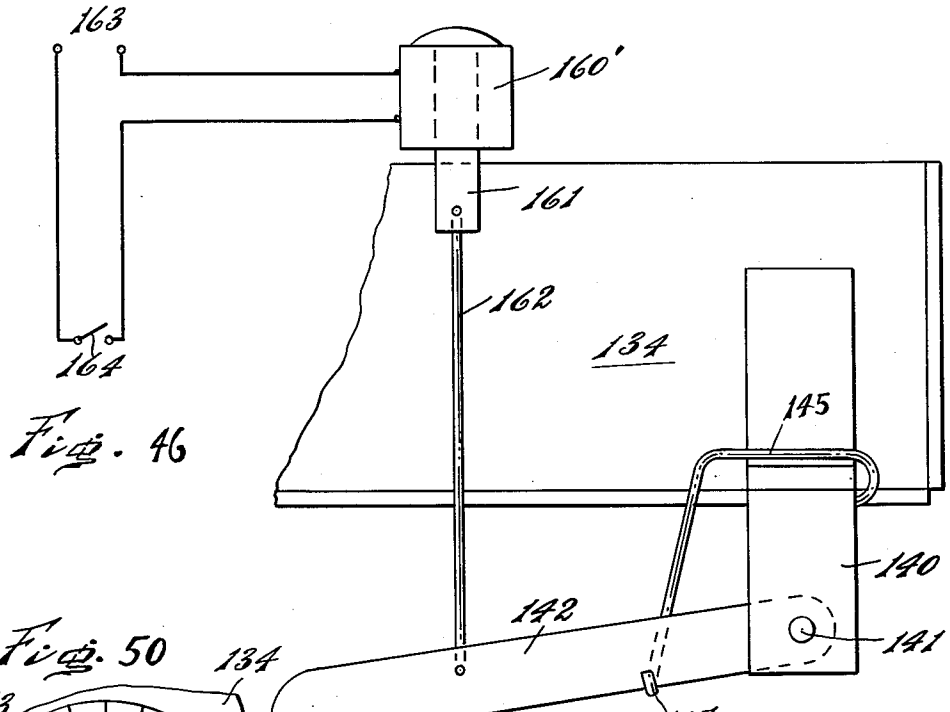


Fig. 46

Fig. 50

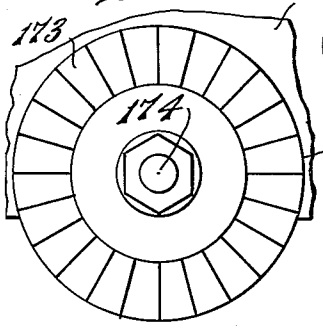


Fig. 48

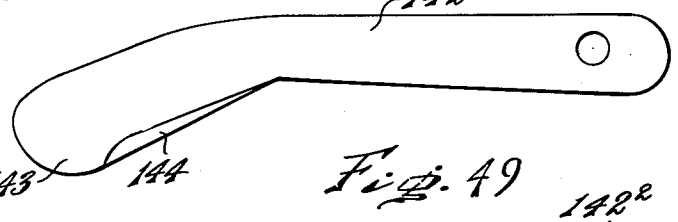


Fig. 49

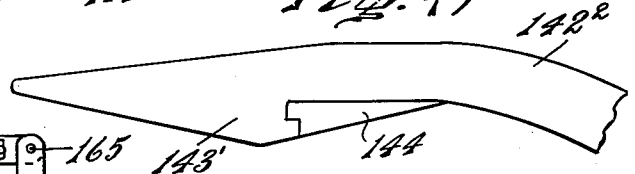
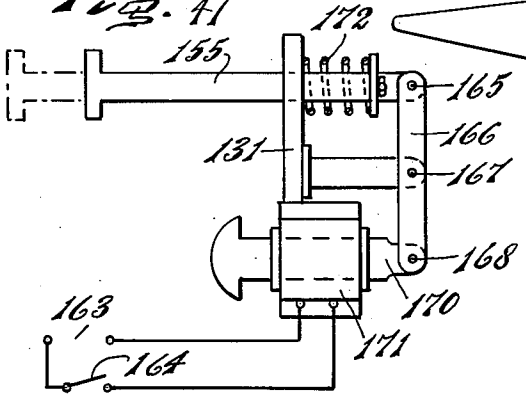


Fig. 47



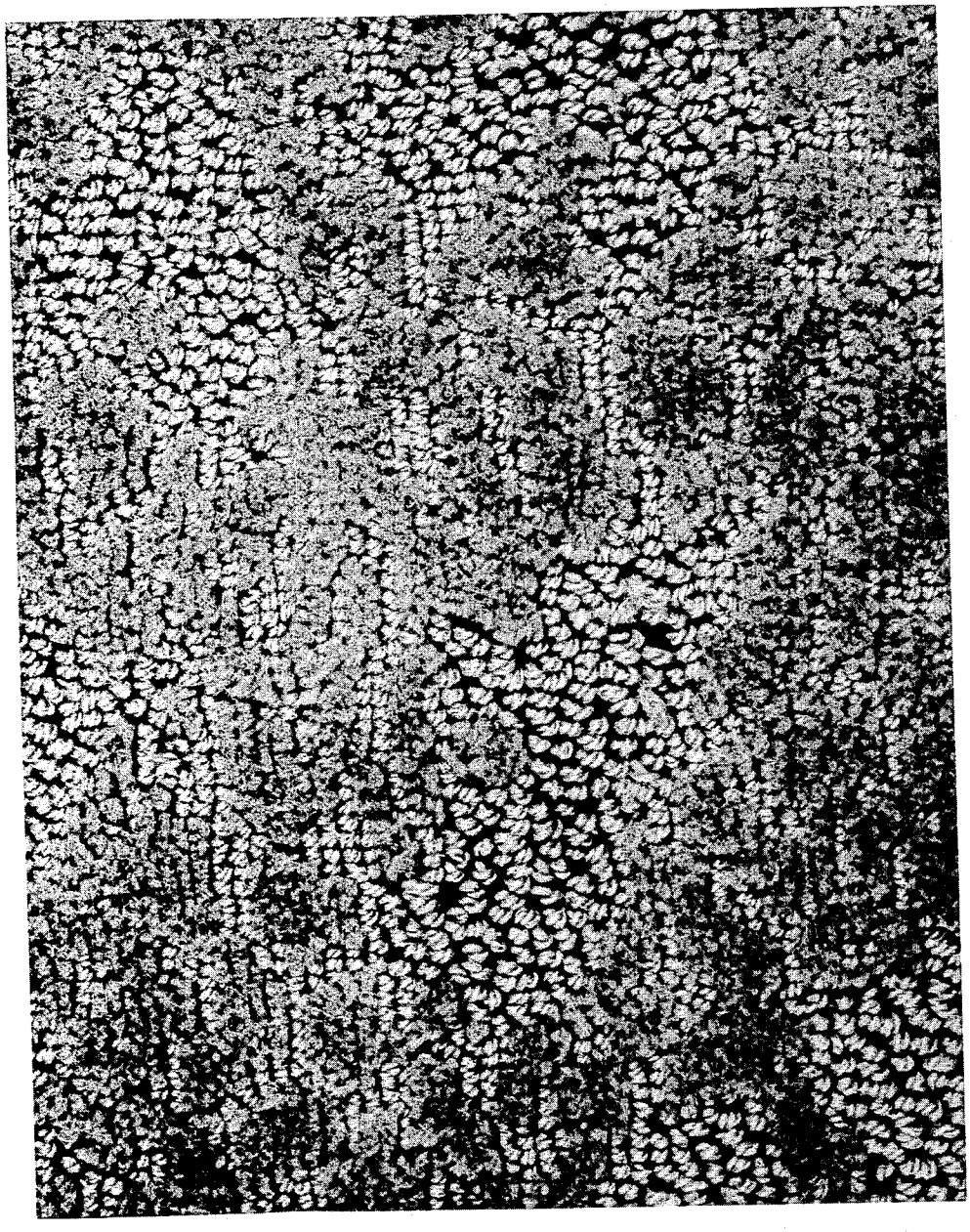
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Fig. 51.



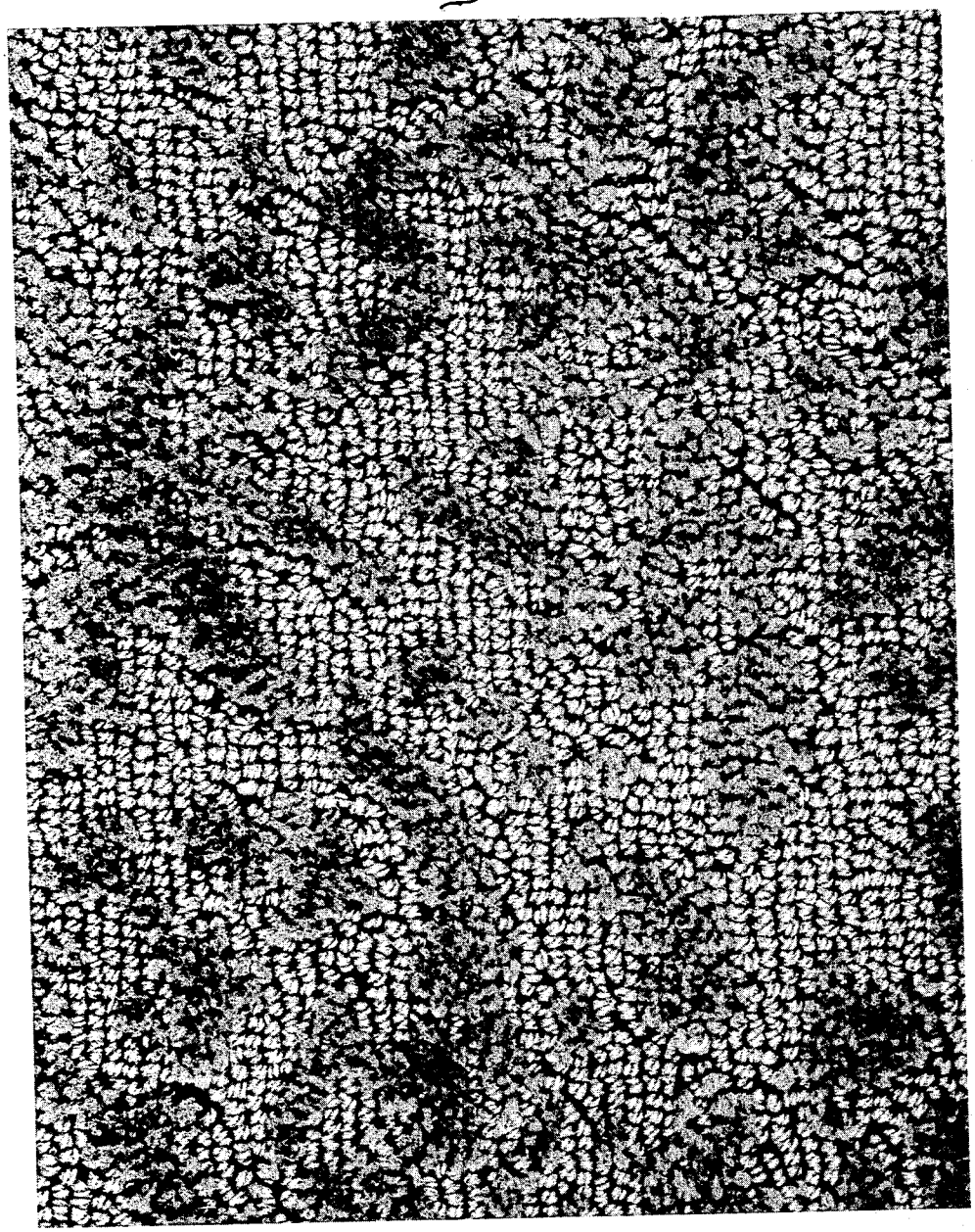
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Oct. 30, 1962 E. M. HOFFMAN 3,060,974

METHOD OF WEAVING AND LOOM

Filed Oct. 18, 1960 16 Sheets-Sheet 16

Fig. 52.



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METHOD OF WEAVING AND LOOM

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The present invention relates to methods of weaving, looms and fabrics. The invention applies to pile fabric woven over transverse pile wires, such as carpets and rugs.

The principles of the invention in their broadest application are capable of being applied to transverse wire looms.

A purpose of the invention is to float in the face or pile of a fabric pile yarn over two or more pile wires, and then to cut the pile yarn from above at a point intermediate between such wires or intermediate between the legs of the float loops thus produced.

A further purpose is to weave a pile fabric over transverse pile wires, forming high floats over two or more pile wires and weaving the wires into the fabric, and then to cut from above such floats after the pile wires have been woven into the fabric and before the pile wires have been removed from the fabric and preferably at the middle of such floats.

A further purpose is to form high floats over two or more pile wires and above one, two, three or more pile binding yarn ends, and to cut such floats from above at a position intermediate between the pile wires.

A further purpose is to locate the point of cutting from above at a position near the middle of a transverse wire set, between the first and the last wire.

A further purpose is to extend the cutter down between two pile wires during the operation of cutting floats from above. One of the great advantages of the invention is that the wires can be used to guide the cutter, and this is best achieved when the cutter is inserted between transverse pile wires on either side beyond the fabric. The pile wires have a certain amount of lateral flexibility, and once the cutter is inserted between the pile wires the cutter is guided to remain between that pair of wires as it moves across a transverse wire loom, The insertion of the cutter between the pile wires is facilitated by reducing the thickness of the wires at the top thereof at the point beyond the fabric where the cutter is inserted, so as to provide more space between the wires at the top, and to prevent the cutter from interfering and hanging up on top of a pile wire.

A further purpose is to form cut pile which is higher than normal pile by cutting from above floats over two or more pile wires at intermediate positions on such floats, the normal pile being cut or uncut as desired.

A further purpose is to avoid cutting normal pile loops while cutting the float loops from above.

A further purpose is to form face yarn pile floats over one pile wire and over one or two or more pile binding yarn ends and to avoid cutting from above such floats over one pile wire while at the same time cutting from above floats which extend over two or more pile wires,

A further purpose is to apply certain aspects of the invention to velvet weaving and to apply certain aspects of the invention to Wilton weaving.

The invention is also applicable to weaving which is neither velvet nor Wilton per se, such as single shot or three shot fabrics, fabrics woven through to the back, and to fabrics made with a binding weft shot, a binder warp, and a warpwise face pile held under the weftwise shots but without a back shot, the backing being later put

on by latex or by bonding a prewoven fabric, sometimes called lamination.

A further purpose is to form staggered or basket weave high floats of two or more pile yarn sets or frames in succession across the fabric, with or without normal single wire pile, said staggered floats extending over two or more pile wires, and said pile wires being straight or wavy as desired, and cutting from above at least some of said staggered floats.

A further purpose is to tie in the pile wires when weaving staggered multiple wire floats to be cut from above, by normal single wire pile loops at intervals.

A further purpose is to weave staggered multiple pile wire floats over pile wires and to selectively cut such floats from above at positions between the wires.

A further purpose is to weave multiple pile wire floats over pile wires which are at different heights on opposite ends of the float and to cut said floats at positions intermediate between the pile wires from above.

A further purpose is to weave multiple pile wire floats over wavy pile wires and to cut such floats from above at positions intermediate between the pile wires. It will be evident that the opposite ends of each float may be over wavy wire portions which are both of similar heights or both of different heights on the respective wires as desired.

A further purpose is to weave multiple pile wire floats over the low portions of wavy pile wires and to cut said floats from above at positions intermediate between the pile wires.

A further purpose is to weave multiple pile wire floats over low portions of wavy pile wires and to weave normal pile loops over high portions of single wavy pile wires, to cut the multiple wire floats over the low portions from above at positions intermediate between the pile wires and subsequently to withdraw the pile wires without producing robbing of previous loops since the remaining loops over the wire being withdrawn are only over the high portions of the pile wires.

A further purpose is to weave multiple pile wire floats over low portions of wavy pile wires having cutters at the end remote from the head beyond the shed, to weave normal pile loops over high portions of single wavy pile wires, to cut the multiple wire floats from above at positions between the pile wires, and then to withdraw the pile wires and cut the normal pile loops without robbing previous loops since the loops formed over the pile wire being withdrawn are formed only over the high portions of the wavy pile wire.

A further purpose is to weave multiple pile wire floats over transverse pile wires having noncutting spoons or flags at the ends opposite to the head beyond the shed, to cut the floats from above at positions between the pile wires, and then to withdraw the pile wires successively, raising normal loops formed over single wires to the height of the spoon or flag and causing robbing of previously formed cut from above pile at the edge of a cut-from-above float area to produce a gradation in pile height.

A further purpose is to weave multiple pile wire floats over transverse cutting pile wires which may be either straight or wavy pile wires, to cut the floats from above intermediate between the legs of the float loops, and subsequently to withdraw the pile wires.

A further purpose is to weave multiple pile wire floats over pile wires and to selectively cut such floats from above between the pile wires, the cutting being selective at intervals along the length of the pile wires, or being selective as to depth, or being employed only in certain rows, or any combination thereof, and subsequently to remove the pile wires from the fabric.

A further purpose is to form low pile yarn floats over pile binding wefts close to the back of the fabric, and to cut, score or rough up said low floats at a position intermediate between pile wire positions after the weaving and before removal of the pile wires to improve the coverage in the wells (that is, areas where low under-the-wire floats are present and visible at the face of the fabric).

A further purpose is to operate a pile yarn float cutter which moves down into a position between two transverse pile wires, woven into the fabric, which cuts on one cutter stroke and which raises or retracts on the return stroke with respect to the fabric.

A further purpose is to retrace a pile yarn float cutter moving between transverse pile wires woven into a fabric, on the cutting stroke beyond the weave before the cutter encounters spoons or cutters on the ends of the pile wires.

A further purpose is to provide a pile yarn float cutter with a guiding shoe which rides between the wires on or above the back of the fabric and prevents the cutter from penetrating beyond a predetermined depth.

A further purpose is to employ a downwardly inclined cutter knife moving in the space between two pile wires woven into a fabric and to vary or set the angle of the knife with respect to the distribution of the pile yarn float loops to be cut.

A further purpose is to employ a rotary pile yarn float cutter which travels between pile wires woven into a pile fabric and which cuts said floats from above which are over two or more pile wires or over one or more pile binding yarn ends.

A further purpose is to utilize a trailing shoe on a knife, both of which are travelling parallel with and between pile wires, and actuated from above, especially wavy wires, woven into a fabric, said shoe having a length greater than the maximum length of low portions of said wavy pile wires, to prevent the shoe and cutter from jumping across from one pile yarn float row to the next.

A further purpose is to cut multiple wire high floats from above at positions intermediate between the legs of the loops of such floats, while avoiding cutting of any other pile formation below the said high floats.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate a few only of the numerous embodiments in which the invention may appear, selecting the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

The weave diagrams show the weave formation in the dent which is in the plane of the paper, and in addition in numerous cases show the formation of the fabric in a dent or dents behind the plane of the paper. Thus it will be evident that the illustration is essentially the same in the case of a two-frame pile fabric from the standpoint of a longitudinal section, whether a full threading-in is used with an end of each frame in each dent, or whether the ends of the different frames are threaded in at least alternate dents, or whether crowding is used, with in some cases ends of each frame or a partial frame present in a particular dent, and in other cases ends of one frame only present in one dent and ends of another frame only present in the next dent as desired.

FIGURE 1 is an expanded warpwise sectional weave diagram of a pile fabric according to the invention woven over straight noncutting pile wires and exhibiting two wire high floats, normal high pile and wells.

FIGURE 2 is an expanded warpwise sectional weave diagram showing the fabric of FIGURE 1 after cutting of the high floats from above according to the invention and withdrawal of the wires.

FIGURE 3 is an expanded warpwise sectional weave diagram of a two-frame pile fabric having staggered two-wire floats woven over straight noncutting pile wires.

FIGURE 4 is an expanded warpwise sectional weave diagram showing the fabric of FIGURE 3 after cutting of the floats in accordance with the invention and after subsequent withdrawal of the wires.

FIGURE 5 is an expanded warpwise sectional weave diagram showing a fabric having staggered low floats, which may represent the well areas in a pile fabric.

FIGURE 6 is a view corresponding to FIGURE 5 which shows the effect of cutting the low floats at positions corresponding to the positions between the pile wires, and after withdrawal of the pile wires.

FIGURE 7 is an expanded warpwise sectional weave diagram of a two-frame pile fabric having normal pile and two-wire high floats woven over noncutting wavy pile wires.

FIGURE 8 is a view corresponding to FIGURE 7 showing the fabric of FIGURE 7 after cutting of the floats from above and subsequent withdrawal of the wavy pile wires.

FIGURE 9 is an expanded warpwise sectional weave diagram showing a two-frame pile fabric having two-wire high floats from both frames woven over low portions of wavy pile wires and normal pile woven over high portions of the wavy pile wires, the wavy pile wires having cutters at the ends remote from the heads beyond the shed.

FIGURE 10 is a view corresponding to FIGURE 9 showing the fabric of FIGURE 9 after cutting of the floats from above at positions between the pile wires and subsequent withdrawal of the pile wires.

FIGURE 11 is an expanded warpwise sectional weave diagram showing a fabric similar to that of FIGURE 3, woven over straight noncutting pile wires, which however are of different heights.

FIGURE 12 is a view similar to FIGURE 11 showing the fabric of FIGURE 11 after cutting of the floats from above and subsequent withdrawal of the pile wires.

FIGURE 13 is an expanded warpwise sectional weave diagram of a two-frame pile fabric showing two-wire high floats and also normal pile loops woven over straight noncutting pile wires which are of different height. Floats are formed over high pile wires and over low pile wires and over high and low pile wires.

FIGURE 14 is a view corresponding to FIGURE 13 showing the fabric of FIGURE 13 after cutting of the floats from above between the pile wires and subsequent withdrawal of the pile wires.

FIGURE 15 is an expanded warpwise sectional weave diagram showing a two-frame pile fabric according to the invention with each frame having two-wire high floats and also normal pile loops and also low floats, the pile being woven over straight cutting pile wires.

FIGURE 16 is a view corresponding to FIGURE 15, illustrating the fabric of FIGURE 15 after cutting of the floats from above between the pile wires, but before withdrawal of the pile wires.

FIGURE 17 is a view corresponding to FIGURE 16 showing the fabric of FIGURES 15 and 16 after withdrawal of the pile wires which have cut the normal pile loops.

FIGURE 18 is an expanded warpwise sectional weave diagram of a two-frame pile fabric according to the invention in which one frame has two-wire high floats and low floats and the other frame has normal pile loops and low floats, the pile being woven over straight noncutting pile wires.

FIGURE 19 is a view corresponding to FIGURE 18 showing the fabric of FIGURE 18 after selective cutting from above of certain of the floats, leaving other floats uncut, and after subsequent withdrawal of the pile wires. It will be evident that FIGURE 19 shows the structure of a fabric in dents behind the plane of the paper.

FIGURE 20 is an expanded warpwise sectional weave diagram of a two-frame pile fabric, having staggered two-wire high floats woven over straight noncutting pile wires.

FIGURE 21 is a view corresponding to FIGURE 20 showing the fabric of FIGURE 20 after cutting from

above the high floats in selective rows and leaving the high floats in other rows uncut, and after subsequent withdrawal of the pile wires. It will be evident that FIGURE 21 shows fabric structure in dents behind the dent which is in the plane of the paper.

FIGURE 22 is an expanded warpwise sectional weave diagram showing a single frame pile fabric having normal pile loops and also two-wire high floats woven over both high and low portions of wavy noncutting pile wires.

FIGURE 23 is a view corresponding to FIGURE 22 showing the fabric of FIGURE 22 after cutting from above the high floats which are over the high portions of the wavy pile wires, and subsequently withdrawing the wavy pile wires.

FIGURE 24 is an expanded warpwise sectional weave diagram showing a two-frame pile fabric woven over noncutting wavy pile wires, the pile yarn forming two-wire high floats over both high and low portions of such wavy pile wires. FIGURE 24 shows structure of the fabric behind the dent which is in the plane of the paper.

FIGURE 25 is a view corresponding to FIGURE 24, showing the fabric of FIGURE 24 after selective cutting of the high floats and subsequent withdrawal of the pile wires. It will be evident that a portion of the fabric is shown which is behind the dent which is in the plane of the paper.

FIGURE 26 is an expanded warpwise sectional weave diagram showing a two-frame pile fabric woven over straight noncutting pile wires. One frame forms two-wire high pile floats and also low floats and the other frame forms normal pile loops and low floats. FIGURE 26 is similar to FIGURE 1 and is useful in showing the operation being performed in cutting from above in FIGURE 27 in a somewhat different manner from that in which FIGURE 1 was cut.

FIGURE 27 is a view corresponding to FIGURE 26, showing the fabric of FIGURE 26 after selective cutting from above to cut the high floats in certain rows, and after subsequent withdrawal of the pile wires.

FIGURE 28 is an expanded warpwise sectional weave diagram of a two-frame pile fabric, illustrating formation of staggered four-wire high floats over straight noncutting pile wires also having normal pile loops.

FIGURE 29 is a view corresponding to FIGURE 28, showing the fabric of FIGURE 28 after cutting of the high floats from above and subsequent withdrawal of the pile wires.

FIGURE 30 is an expanded warpwise sectional weave diagram showing a two-frame pile fabric formed over straight noncutting pile wires. One frame forms normal pile loops, two-wire high floats over a single pile binding yarn end, two-wire, high floats over two pile binding yarn ends, and two-wire high floats over three binding yarn ends, and the other frame forms normal pile loops.

FIGURE 31 is a view corresponding to FIGURE 30, showing the fabric of FIGURE 30 after cutting of the high floats from above and subsequent withdrawal of the pile wires.

FIGURE 32 is a view similar to FIGURE 30, but showing the fabric formed over different height noncutting wavy pile wires. FIGURES 32 and 33 show the structure of the fabric in dents behind the dent which is in the plane of the paper.

FIGURE 33 is a view similar to FIGURE 32, but illustrating the high floats cut from above and the noncutting wavy wires subsequently withdrawn.

FIGURE 34 is an expanded warpwise sectional weave diagram showing a two-frame pile fabric woven over straight noncutting pile wires. Each frame forms two-wire high floats, and also forms floats over one pile wire and one pile binding yarn end and over one pile wire and two pile binding yarn ends.

FIGURE 35 is a view similar to FIGURE 34, after cutting of the two-wire high floats from above without cutting the one-wire floats, and subsequent removal of the pile wires.

FIGURE 36 is an expanded warpwise sectional weave diagram, showing the pile wires beyond the section in perspective, illustrating normal pile and also two-wire high floats woven over flag or spoon wires.

FIGURE 37 is a view corresponding to FIGURE 36, showing the effect on the fabric of FIGURE 36 of cutting the high floats from above and subsequently removing the flag or spoon wires.

FIGURE 38 is a fragmentary diagrammatic side elevation of a flag or spoon wire as illustrated in FIGURE 36.

FIGURE 39 gives a fragmentary diagrammatic top plan view of a transverse wire pile fabric loom to which the invention is applied, with the wire hopper in position for withdrawing a wire.

FIGURE 40 is a view corresponding to FIGURE 39 with the wire hopper shown in position to insert a transverse pile wire into the shed.

FIGURE 41 is an enlarged fragmentary top plan view of the portions of FIGURES 39 and 40 showing the wire set, and illustrating the cutter of the invention applied to the loom.

FIGURE 42 is an elevation of the cutter mechanism of the invention from the weaver's side of the loom.

FIGURE 43 is a diagrammatic transverse section of FIGURE 42 on the line **43—43**.

FIGURE 44 is an enlargement of FIGURE 43 showing the cutter of the invention.

FIGURE 45 is an elevation of the cutter of the invention viewed from the side of the loom adjoining the heddles or the lay.

FIGURE 45*a* is a view similar to FIGURE 45 showing a modification in which the cutter is selectively moved to different depths of cut between the wires.

FIGURE 46 is a fragmentary view similar to FIGURE 45 but showing a variation in which the position of the cutter is manipulated by a solenoid.

FIGURE 47 is a fragmentary top plan view of a variation in the means for lowering the cutter of FIGURE 45 at the side of the loom adjoining the wire motion.

FIGURE 48 is a side elevation of a variant form of cutter according to the invention.

FIGURE 49 is a fragmentary side elevation of a further variant form of cutter according to the invention, in retracted position.

FIGURE 50 is a fragmentary side elevation of a further variant form of cutter according to the invention.

FIGURES 51 and 52 are photographic face views of fabrics according to the invention.

FIGURE 53 is a fragmentary side elevation of a preferred transverse pile wire for use in the present invention, showing the reduction of the thickness of the wire at the top on the portion of the wire which is beyond the fabric, in this case at the head end.

FIGURE 54 is a section of the wire of FIGURE 53 on the line **54—54**.

FIGURE 55 is a section of the wire of FIGURE 53 at the point where the fabric is woven, taken on the line **55—55** of FIGURE 53.

Describing in illustration but not in limitation and referring to the drawings:

In the usual practice of weaving with transverse pile wires, cutting of loops on the loom is usually accomplished by cutters which are positioned at the ends of the wires remote from the head beyond the shed. So-called umbrella wires having grooves at the top have also been employed, and in this case a cutter running in such groove has been moved longitudinally of the wire along the top of the wire. The cutter moving along the umbrella wire was in some cases hand operated and in other cases mechanically actuated.

In either case the effect was to produce a cut tuft which was relatively similar in height to the height of the normal pile loop.

In some cases, random and pattern selective shearing have been applied to the face of a fabric with the view to forming cut pile of variant height or cut and uncut pile. In this case it has been difficult to obtain a precisely regulated height of pile at any given point.

In the case of pile fabrics woven over longitudinal wires whether the pile is formed from warp yarns or weft yarns, the practice has been to provide cutters on or above the wires which cut the pile formed over individual wires.

In accordance with the present invention, high floats are formed over two or more pile wires in a transverse pile wire fabric which in some cases will be produced on the velvet loom and in some cases on the Wilton loom or on modified versions of either, and the high floats are cut after the completion of the weaving in of the pile wires and while the pile wires are still woven into the fabric, by a cutter operated from above along a line intermediate between two pile wires or intermediate between the anchorages of the legs of the floats. The point of cutting will in most cases preferably be at the middle of the float. The float in many cases will be a two-wire high float, but other lengths of high floats may be used, for example, three, four or more wire high floats. The floats may vary in the number of pile binding yarn ends over which the floats span, and for example in two-wire high floats the floats may span one, two or three such binding ends. Similar variations will exist in the case of high floats over more than two wires.

The cutter which accomplishes the cutting from above will suitably extend down between two pile wires, but will not extend far enough down to cut the back of the fabric and thus damage the backing yarns.

In order that the wires may adequately support the pile which is being cut from above, the cutting is desirably accomplished at a position intermediate between the first and the last wire of the pile wire set. The pile wires are resilient in the fabric and the cutter shoe will suitably slightly force the pile wires apart as it moves in the space between the adjoining pile wires.

The effect will be to produce cut floats which are slightly higher than normal pile, other conditions being equal. Thus, the fabric can have loops formed over individual pile wires and bound on either side beneath adjoining pile binding yarn ends, and these normal pile loops will not be cut by the cutting from above, but when the wires are removed can either remain uncut, where the pile wires are noncutting wires, or can be cut when the pile wires are removed, by cutters on the ends of the pile wires remote from the head and beyond the shed.

Not only will the cutting from above avoid cutting normal pile loops, but it will also avoid cutting floats over a single pile wire, which are floating over one or two pile binding yarn ends, and thus uncut pile of an intermediate height between the high multiple wire float tufts and normal pile can be obtained if desired.

If wavy pile wires are used, normal pile can be formed over the wavy pile wires and when the wavy pile wires are withdrawn, robbing of previous loops will take place where loops are carried over low portions of the wavy pile wires.

If desired, however, normal loops can be formed only over high portions of the wavy pile wires, and then the wavy pile wires can be withdrawn without robbing previous loops, leaving uncut loops of uniform height, or if the wavy pile wires are cutting, forming cut tufts of uniform height. It will be evident that in producing a fabric of the type under discussion, proper coordination of the wavy wire pattern and the jacquard pattern is important.

Thus, the pile wires themselves can be cutting wires, and if cutting wires, can be either straight or wavy wires.

The pile wires themselves also can be spoon or flag wires, having noncutting high portions at the ends remote from the head beyond the shed. If multiple wire high floats are formed by the same pile frame, or pile warp set, when the spoon or flag wire is withdrawn from a loop over a single wire after cutting of the floats from above, robbing of the previous pile projection will take place, tending to form a gradation in the pile heights.

The high floats themselves may be over straight pile wires and the straight pile wires may be of uniform height or of different heights, in which case the high floats may be over a high pile wire at one end of the float and a low wire at the other end of said float. If wavy pile wires are used, the floats may be over high portions of the wavy pile wires or low portions of the wavy pile wires or over both high and low portions of the wavy pile wires.

In this case interesting effects can be obtained by cutting from above high floats which are only over the high portions or only over the low portions or sometimes over the high portions and sometimes over the low portions, since tufts of different heights will be produced.

The staggered high floats over two or more pile wires will be used in some cases, and in this instance it may sometimes be desirable to use normal pile loops at intervals to hold the pile wires in the fabric until withdrawn from the fabric.

Selective cutting of high multiple wire floats can be used by cutting at intervals along each row and not cutting at other intervals, or by cutting to varying depths, or by cutting only in certain rows, or by any combination of these selective cutting procedures.

Improvements in coverage in the wells where low floats appear may be obtained by cutting the low floats or by merely abrading or roughing up the low floats at positions which correspond to those intermediate between pile wires or intermediate between the anchorages of the low floats.

The cutter may be manipulated by hand if desired, but it is preferably operated by the mechanism of the loom. The cutter will desirably cut during motion in one direction transversely of the float, and will avoid cutting in reverse travel. The cutter should be elevated at positions of the spoons or the knives on the ends of the wires beyond the shed.

The cutter will in some cases desirably be provided with a shoe which rides along the front of the back of the fabric at the base of the pile, and protects against having the knife penetrate too deep, and the shoe may in some cases be elongated to prevent the cutter from jumping from one float row to the next, especially where wavy wires having extremely low portions in the profile are used.

The width of the cutter shoe will vary with the number of wires per inch, the tightness or looseness of the weave, the diameter of the pile yarn, and the space between the wires which support the high floats in the case where no projections beneath the high floats are to be cut.

In some cases a rotary cutter will be employed.

In the above discussion, emphasis has been placed on weaving floats over transverse pile wires. It will also be evident that floats can be woven over longitudinal pile wires and the principles of the invention may be applied to the cutting of the floats over longitudinal pile wires from above.

I illustrate in FIGURE 1 a pile fabric, suitably a carpet or rug, which has been woven and is still on the loom, showing the transverse pile wires in place. A typical Wilton loom of the type which may be employed is shown in Harding U.S. Patent 2,477,248. Binder warp sets **70** and **71** are woven preferably on a two-shot basis with a stuffer warp set **72**, pile warp frames or sets **73** and **74**, upper or binding wefts **75** and lower or back wefts **76**.

At the step in the cycle at which an upper or pile binding weft **75** is to be inserted, in FIGURE 1, one of the binder warp sets is raised half-way and all other warp sets except those pile warp ends which are selected to float are lowered, the ends which are selected to float are raised at least half-way, and the binding weft **75** is inserted.

At the next step in the cycle, the binder warp sets are

in the same relative position, and the stuffer warp set 72 is raised half-way, forming a lower shed. The pile warp sets 73 and 74 if selected are fully raised (above the wire position), forming an upper shed. A wire 77 is inserted in the upper shed and a lower or back weft 76 is inserted in the lower shed.

Before the next step in the cycle, the binder warp sets reverse, and in the next step in the cycle normal pile is bound beneath the next binding weft and pile which is to remain in the high floating position remains in the position above the binding weft. Thus, normal pile loops 78 bound beneath adjoining binding wefts are formed from selected ends of pile warp set 74, and high two-wire floats 80 are formed on the other pile warp set. Each of the pile warp sets also forms in well areas 82 low floats 81 which are above one binding weft and bound beneath binding wefts on either end of said floats.

The wires 77 in FIGURE 1 are shown as being plain or straight noncutting pile wires of any suitable height.

After several wires of the wire set have been interwoven in the fabric according to usual practice, but before the first wire of the set has been withdrawn, the two-wire high floats 80 are cut at a point intermediate between the pile wires to form tufts 83 which are of greater height compared to the normal pile as shown in FIGURE 2. Since the cutting is desirably done intermediate between the two wires of a particular high float, or intermediate between the legs of the float loop, by a cutter from above, the tufts are of equal length. The cutting does not cut the normal pile loops 78 which remain unchanged.

In the form of FIGURE 3 both pile yarn warp sets form two-wire high floats in staggered relation to one another over the straight noncutting pile wires 77, and after the pile wires have been woven in, cutting from above is accomplished row by row along the line of the middle of each row of floats, resulting in the high tufts 83 of FIGURE 4. If desired, loops of normal pile can be employed at intervals to hold the pile wires in the fabric after the cutting from above and before the pile wires are withdrawn as in normal practice.

The fabric of FIGURES 3 and 4 can be produced on a velvet loom without the necessity of using a jacquard as in Wilton practice, cutting from above all or substantially all of the staggered multiple wire high floats, or the same general type of fabric can be produced over wavy pile wires as later explained. Likewise, with this fabric the cutting from above can be controlled according to a pattern sequence, sometimes cutting and sometimes not cutting the high floats as later explained. Of course, the fabric of FIGURES 3 and 4 can be produced with normal cut or uncut pile in the background, if desired.

In FIGURE 5 I illustrate a well area of a pile fabric having staggered low pile yarn floats 81. The principles of the invention can be employed as shown in FIGURE 6 to improve the coverage in this well area by reducing the leanness of the face yarn. This can be accomplished by running a cutter transversely of the low float loops intermediate and preferably at the middle between the anchorages of the staggered low floats, on a line which would correspond to the middle of the space between two pile wires. Precautions should be taken to avoid cutting the back of the fabric as by the use of a suitable guiding shoe on the cutter as later explained. As a result, low tufts 84 can be obtained, or if desired the float cutter may merely abrade or rough up the low floats to improve the coverage in the wells, without completely severing them.

The principles of the invention can also be applied to the wells in a pile fabric where the loops 81 are not in fact low floats but are lower loops of some other character, such as terry loops woven float-fashion.

In FIGURE 7 wavy pile wires 77′ are used of noncutting type, and the two-wire high floats 80 are formed over the high portions of the wavy pile wires, while two-wire high floats 80′ of less great height are formed over

low portions of the wavy pile wires. FIGURE 7 also illustrates the formation of a high float 80^2 which is over a high portion of the wavy wire at one end and over a lower portion of the wavy wire at the other end. The floats may be over the low portions only of the wavy pile wires, in which case normal pile can be formed over the high portions of the wavy pile wires, if desired. By cutting from above at a position intermediate between the pairs of pile wires, FIGURE 8, high float tufts 83 are produced where the float was over the high part of the wavy pile wire and lower float tufts 83′ are produced where the float was over lower parts of the wavy pile wire. Tufts 83′ are formed where the float loop 80^2 was over a high portion of a wavy wire at one end and over a low portion of a wavy wire at the other end.

Where the pile wires are wavy cutting wires 77^2 as shown in FIGURE 9, with high two-wire floats from both pile warp sets 73 and 74 over the wires, the cutting from above intermediate between the wires while the wires are woven in will convert any high floats over high portions of the wavy wires (not shown) to high tufts, and as shown in FIGURE 10, will convert high floats over lower portions of the wavy wires to lower tufts 83′. Then when the wires are subsequently pulled, normal pile loops 78 are converted to normal pile tufts 85 which are still lower. Since, in this form, the normal loops 78 are only over the high portions of the wavy wires, no robbing from adjoining pile projections occurs when the cutting wavy pile wires are pulled.

Thus, there will be produced in FIGURE 10 tufts 83′ formed over low portions of the wavy wires and cut from above and tufts 85 formed over high portions of the wavy wires and cut subsequently when the cutting wavy wires are withdrawn.

FIGURE 11 shows a fabric similar to that of FIGURE 3 formed over noncutting straight pile wires 77, with alternate pile warp sets or frames forming two-wire high floats, but with the wires in this case of differing heights, so that some of the floats are over a high wire and a lower wire, as shown.

After the pile wires have been woven into the fabric, the floats are cut from above at positions intermediate between each two pile wires, resulting in a certain amount of J-tufting, producing tufts 85 having gradations of height, FIGURE 12. In this case as in that of FIGURES 3 and 4 it may be desirable to provide ordinary pile loops at intervals to hold the pile wires in place after the cutting from above until the pile wires are withdrawn.

In FIGURE 13 there is a two-frame or two-pile yarn warp set pile fabric woven over uniform height pile wires of the noncutting type, the pile wires being of different heights, so that there are two-wire high floats 86 over pile wires of the same height and two-wire high floats 87 of camel back variety over pile wires of different heights, one low and one high. After cutting from above at a position intermediate between the pile wires in the successive float rows, the result is some J-tufting as shown at 85 in FIGURE 14. Cut pile is produced except at points of pattern change where ordinary loops 88 result, and these are not cut from above and remain uncut as shown in FIGURE 14.

Where pile wires individually of uniform height but separately of different heights are used, the sequence in heights between wires will vary accordingly to any desired pattern arrangement such as low-high-high-low, or low-medium-high-high-medium-low or a combination thereof. The J-tufting obtained may be desirable to produce carved effects, acting as transitions between higher tufts and low tufts or low loop areas.

FIGURE 15 shows a pile fabric woven over straight cutting pile wires 77^3 of uniform height. Both pile yarn warp sets 73 and 74 form two-wire high floats and also normal pile loops raised over one wire and bound beneath adjoining binding wefts.

FIGURE 16 shows the fabric of FIGURE 15 after the cutter from above has cut the two-wire high floats to form the long tufts **83**, leaving low floats **81** in the wells **82**. The pile wires have not yet been withdrawn.

FIGURE 17 shows the fabric of FIGURES 15 and 16 after the pile wires have been withdrawn, the pile wire blades cutting the normal pile loops **78** to form normal pile tufts **90** on both frames. The result as shown in FIGURE 17 is pile fabric with two heights of pile tufts.

FIGURE 18 shows a pile fabric having two pile yarn warp sets or frames woven over straight noncutting pile wires **77**. One frame or pile yarn warp set forms normal pile loops **78** and low floats **81** and the other forms two-wire high floats **80** and low floats **81**.

FIGURE 19 shows the same fabric after cutting from above has been applied selectively, that is, in each row cutting some of the two-wire high floats and leaving others uncut. FIGURE 19 shows structure in the fabric behind the dent which is in the plane of the paper. Thus, at some points across each transverse row there will be high tufts **83** and at other points in the same transverse row there will be float loops **80** which are higher than the normal pile loops **78**, but lower than the cut-from-above float tufts **83**. After this selective cutting operation by cutting from above, the wires have been withdrawn to produce the finished fabric of FIGURE 19. Low floats **81** are seen in wells **82**. The cutter operates on a line which is intermediate between each pair of pile wires, which define the ends of the float loop, and preferably at the middle, moving up and down relative to the fabric according to a suitable control as later explained so as to cut certain high floats and not others.

FIGURE 20 shows a pile fabric having two-pile yarn warp sets or frames which alternate in forming two-wire high floats as shown at **80**. This fabric may desirably conform with FIGURE 3. At cutting from above positions between certain pairs of pile wires as indicated by arrows **91**, a cutter from above is run after completion of the weaving in of the pile wires, and before the pile wires are withdrawn, while at other points where no arrow **91** is shown there is no cutting from above. Noncutting straight pile wires **77** are used in weaving the fabric.

After cutting from above as just described in selected float rows, and withdrawal of the pile wires, the resulting fabric of FIGURE 21 has in some rows high tufts **83** and in other rows somewhat lower float loops **80**. The selective cutting from above in certain float rows may be accomplished by hand, or special mechanism for this purpose can be used as later described.

It will be obvious that the selective cutting from above by float rows and the selective cutting in different parts of individual float rows as previously shown and described can be employed in the same fabric if desired.

FIGURE 22 shows a pile fabric having a single pile yarn warp set or frame, woven over wavy noncutting pile wires **77'**, two-wire high floats **80** being formed over high and also over low sections of wavy pile wires. After completion of the weaving and before withdrawal of the pile wires, a cutter from above is carried across at a position intermediate between each pair of pile wires at a depth which will cut the floats over the high portions of the wavy pile wires but not cut the the floats over the low portions of the wavy pile wires. This retains uncut float loops which were formed over the low portions of the wavy pile wires in uncut condition. When the pile wires are subsequently withdrawn, the result is high cut tufts formed by cutting from above, the floats over the high portions of the wavy pile wires, as shown at **83**, float loops **80** which were formed over the low portions of the wavy wires and tufts **92** lowered by robbing a prior cut-from-above tuft from withdrawal of the adjoining wavy wire as well known in the art, as shown in FIGURE 23. This permits robbing from the side of the wire from which robbing was previously not possible.

It will be understood that in some cases it will be desirable to synchronize the wire pattern and the jacquard pattern in weaving according to FIGURES 22 and 23. In some cases, however, adjustment of the depth of cutting from above will be accomplished so as to cut the high floats which are over high portions of wavy wire at both ends, while leaving uncut the camel back floats which are over high portions of wavy wires at one end and over low portions of wavy wires at the other end.

It will be evident of course that the design can if desired provide floats whose ends are only over the high portions or only over the low portions of the wavy pile wires, or this can be done in certain areas. This makes it possible to have the cut-from-above pile formed from the low pile wire portions, if the cutter is made to cut pile floats over the low portions, having the same height as uncut pile formed over the high portions in certain adjoining areas. In this case the float cutter is manipulated up and down relative to the fabric to cut to different depths between wires at different positions transversely of each float row as later explained.

FIGURE 24 shows a pile fabric having two pile yarn warp sets or frames which form floats over high and low portions of the wavy pile wires **77'**, of noncutting character. The cutting-from-above technique is applied so as to cut selectively only certain high floats and only certain low floats, leaving some floats uncut. Thus, in row A high and low floats are cut as will be seen in FIGURE 25, in row B the high floats only are cut, and in row C both the high and the low two-wire over-the-wire floats are left uncut. When the pile wires are pulled after completion of the cutting from above, the resulting fabric as shown in FIGURE 25 involves high tufts **83** and two-wire high float loops **80** which are of various heights as determined by the wavy wires influenced by robbing.

When the noncutting wavy pile wires are removed, this will in certain cases influence the height of adjoining pile projections by robbing. Uniquely compared to other fabrics, this robbing can take place in both directions, forward of the wire which is in process of removal or rearward of that wire, depending on the circumstances. Thus the loop **89** has been pulled down by robbing action as known in the art. Also, one of the prior cut-from-above high float tufts **89'** has been reduced in height by robbing of a unique character, which takes place on tufts formed adjacent to wires that still remain woven in the fabric.

Where it is desired to have the cutter cut-from-above high float loops but not lower float loops in a particular float row, this can readily be accomplished by adjusting or setting the depth to which the cutter knife extends down in between the pile wires.

FIGURE 26 shows a pile fabric having two pile yarn warp sets or frames woven over straight noncutting pile wires **77**, to form normal pile loops and low floats on one frame and two-wire high floats and low floats on the other frame. After cutting from above at a position intermediate between some of the wires, leaving other float rows uncut, the result in FIGURE 27 after withdrawing the wires is high cut tufts **83** and uncut somewhat lower float loops **80**, low normal loops **78**, and low floats **81** in the wells **82**.

In the above specific illustrations the high floats have been two-wire high floats, but it will be evident that the high floats can extend over more than two wires. Where the high floats extend over more than two pile wires it will be evident that they can be cut from above without cutting fabric projections or structure which is beneath them.

FIGURE 28 shows a pile fabric having two-pile yarn warp sets or frames **73** and **74**, each of the frames forming normal pile loops over single pile wires bound beneath binding wefts on each end, and also four-wire high floats **93**, the floats being alternate as shown. After the

weaving has been completed and the pile wires are woven in but not yet withdrawn, cutting from above of the four-wire high floats **93** at a position intermediate between the two center wires of the four-wire groups is accomplished at the position of the arrows **94**, resulting in exceptionally high tufts **83²** and normal uncut pile loops **78** after the wires are withdrawn as shown in FIGURE 29. In order to accomplish cutting from above at the desired positions **94** in FIGURE 28 it is important to use a pattern controlled cutting which will omit cutting from above in two-pile-wire rows as shown.

In the previous description the two-wire high floats are woven over two-pile wires and over one binding weft. This will however not necessarily be the case and in FIGURE 30 I show a pile fabric having two pile yarn warp sets or frames, woven over straight noncutting pile wires. One pile warp set forms normal pile loops **78** and the other pile warp set forms normal pile loops **78**, two-wire high floats **80** floating over one binding weft, two-wire high floats **95** floating over two binding wefts, and two-wire high floats **96** floating over three binding wefts.

FIGURE 31 shows the same fabric after the cutter from above has run in the space intermediate between each pair of wires, resulting in tufts **83** from cutting from above a float **80** over one binding weft, uneven height tufts **97** from cutting from above two-wire high float **95** over two binding wefts, and still higher tufts **98** of even height from cutting from above a two-wire high float **96** over three binding wefts. The resulting fabric as seen in FIGURE 31 after withdrawal of the non-cutting pile wires has a carved effect with several heights of pile tufts as well as uncut normal pile loops in the pile background.

FIGURE 32 shows a fabric similar to FIGURE 30 but woven over wavy noncutting transverse pile wires having different maximum heights. One pile yarn warp set or frame **74** forms normal pile loops **78** over a single pile wire bound beneath adjoining binding wefts. The other pile yarn warp set or frame **73** forms such normal pile loops **78**, forms camel back two-wire high floats **87'** over one binding weft, forms camel back two-wire high floats **100** over two binding wefts and forms camel back two-wire high floats **101** over three binding wefts. After completion of the weaving and before the pile wires are withdrawn, cutting from above is accomplished at an intermediate line between each pair of pile wires, and the result is, as shown in FIGURE 33, uneven height tufts **102** from loops **87'**, uneven height tufts **103** from loops **100**, and uneven height tufts **104** from loops **101**, individual tufts being of selectively different heights, so as to give a pronounced carved effect, with a pile background of wavy normal pile loops **78** accomplished by robbing when the wavy wires are pulled out. Different forms of pile background can be accomplished by weaving the fabric of FIGURES 32 and 33 over either cutting straight pile wires or cutting wavy pile wires as desired.

In some cases it is desirable to utilize partial high floats which will not be cut by the cutter from above, along with full multiple wire high floats which will be cut. FIGURE 34 illustrates a pile fabric woven with two-pile warp sets or frames over straight noncutting pile wires **77**. One pile yarn warp set **74** forms two-wire high floats **80** and also one-wire partial floats **105** over one binding weft and one-wire partial floats **106** over two binding wefts, while the other pile warp set **73** has two-wire high floats **80** and partial floats **105** and **106** along with normal pile loops **78**. After completion of weaving and cutting the two-wire high floats from above between each pair of pile wires, using a cutter which extends down between the pile wires to a limited depth as suggested by the arrow but does not extend down as far as the partial floats, the one-wire partial floats **105** and **106** remain uncut as shown in FIGURE 35, while the two-wire high floats **80** are cut and produce upstanding tufts **83** above a background of the partial floats **105** and **106** and the normal pile loops **78**. The cutter, when cutting from above, passes above the partial floats and if it touches them they tend to yield.

The fabric of FIGURES 34 and 35 can also be made using wavy pile wires and cutting pile wires, the cutting pile wires being either straight or wavy as desired, producing variations in pile background effect.

In some cases it is desirable to weave over noncutting spoon or flag pile wires **77⁴**, as shown in FIGURE 36. The wire itself as shown in FIGURE 38 has a conventional head **107**, a straight body **108** and a high portion or spoon **110** at the end remote from the head beyond the shed. In FIGURE 36 a single pile warp set or frame is woven over the pile wires to form normal pile loops **78** over single wires and two-wire high floats **80**. After completion of weaving but before withdrawal of the pile wires, cutting high floats from above is accomplished at an intermediate position between each pair of pile wires, and the result is the severing of the two-wire high float loops to make high tufts **83**. When the flag or spoon wires are withdrawn, the flags or spoons produce a robbing effect that pulls down the tufts at **111** and forms higher loops **112** since no robbing of previous loops can be accomplished by the next float tufts **83** when the wire is withdrawn. This robbing can involve either pile loops or tufts ahead of the wire or pile tufts behind the wire which is being removed. This gives a very desirable gradation between the low normal pile area consisting of loops **78** and the high tufts **83**.

While the cutting of float loops from above can be accomplished by hand, it is preferable to modify the loom so that it will be accomplished automatically. Considering FIGURES 39 to 44, and particularly FIGURES 39 and 40, I illustrate a carpet loom having heddle frames **113**, right hand and left hand shuttle boxes **114** and **115**, a reed cap **116**, a reed **117**, a wire track **118**, a wire carrier **120**, warp ends **121**, a spike roll **122** and completed carpet **123**. A set of transverse pile wires **124** is woven into the carpet and the wires have wire heads **125**. The breastplate is shown in FIGURE 41 at **126**. A pile wire is shown in FIGURE 40 being inserted into the fabric at **127** and a pile wire is shown being withdrawn from the fabric in FIGURE 39 at **128**. The area on the loom in which cutting from above will take place is shown in FIGURES 39 and 40 at **130**.

Referring now to FIGURES 41 to 45, brackets **131** are placed at opposite sides of the loom, and suitably toward the spike roll of the wire set in order to avoid interference with the wire motion and lay. Of course, the number of wires in the wire set should be adequate to avoid interference with the lay at the point of cutting from above. Said brackets adjustably mount suitably tubular metallic guides **132** extending above the fabric. Sliding transversely on the guides is a cutter carriage **133** best seen in FIGURES 44 and 45 which has a yoke shaped body **134** carrying rollers **135** which roll on the bottom of the guides **132** and rollers **136** which ride on the upper outer portions of the guides **132**. Mounted on the side of and extending above the carriage is a bracket **137** which is suitably connected by a pull rod **138** to the wire carrier **120** so that the cutter carriage moves back and forth with the wire carrier. Extending down from the cutter carriage at the side toward the wire set is a cutter bracket **140** having a pivot **141** which pivotally supports a knife arm **142** which in operative position as shown in FIGURE 45 extends downwardly at an angle. The knife arm at its trailing lower end has a suitably rounded guiding shoe **143** which if desired can ride between pile wires along the back of the fabric and protect the fabric backing against cutting.

Disposed in a recess in the knife arm slightly forward and above the guiding shoe is a knife **144**, suitably a razor blade, which in operative position is adapted to extend down between the pile wires and accomplish the float cutting from above. In the preferred embodiment in operative position, as shown in FIGURE 45, the edge

of the knife which accomplishes the cutting is suitably disposed at about 15° inclined to the horizontal, but other angles may be used as later described. A wire or leaf spring **145** is anchored to the bracket **140** at **146** and anchored beneath the knife arm at **147** to bias the knife arm upward toward retraction from the fabric. A toggle lever **148** is pivoted on the knife carriage at **150** and has a lower end which straddles the knife arm at **151** and which carries a roller **152** engaging the upper side of the knife arm remote from the pivot **141**. The toggle lever has limiting movement positions established by pins **153** and **154** seen in FIGURE 45. The position of pin **153** is adjustable as shown.

As best seen in FIGURES 41 and 42, a bumper **155** is resiliently mounted on one bracket **131** and urged toward the carriage **133** by helical compression spring **156**, so that it encounters the upper end of the toggle lever **148** on the carriage, when the cutter carriage moves toward the side of the loom having the wire motion and moves the cutter down into its operative position. At the side of the loom remote from the wire motion a bumper **157** mounted without interference with the cutter carriage on the guides **132** encounters the upper end of the toggle lever **148** at the end of the stroke so as to retract the cutter upward into inoperative position. As the pile wires at the ends remote from the head will in many cases carry spoons and cutters, or spoons or flags without cutters, and it is desired to avoid interference by the cutter from above, the bumper **157** causes retraction of the cutter upward before spoon portions **158** of the wires are encountered beyond the fabric selvage.

While the device illustrates only one float cutter on the cutter support mechanism extending clear across the loom, it will be evident that a plurality of cutters can be mounted at intervals to cut different portions of the floats across the width of the fabric.

The choice of the position at which the cutter from above will operate with respect to the pile wire set is not limited, except that it is desirable to run the cutter on the cutting stroke between two or more pile wires which are not either at the beginning or the end of the wire set. If one considers that the number 1 pile wire is the wire which is nearest the weaver, it is usually advisable to cut between two pile wires that are around the transverse middle of the pile wire set, so that they will receive maximum support from pile wires on either side even though they are deflected laterally or spread by the cutter as it moves between them. Best practice indicates that cutting from above takes place between about the fifth and sixth pile wires of the sequence.

It has been found that the pile wires when woven into the fabric are sufficiently flexible laterally so that it is possible to insert the cutter from above well down between two-pile wires even when the pile wires are woven very closely together and are extremely thin, as in weaving nine wires per inch of fabric. The invention can also be utilized effectively when weaving with relatively thicker pile wires such as six wires per inch of fabric or less.

In some cases good results have been obtained by relatively thickening the smooth shoe **143** at the trailing end of the cutter so as to spread the wires and protect the sides of the normal loops from abrasion by the cutter. It will be understood that spreading the pile wires tends to tighten the span of the high float loops and make them easier to cut from above.

In FIGURE 45*a* a float cutter mounting arrangement is shown which is selectively moved to different depths of cutting from above between the pile wires. The toggle arm **148** is pivoted at **150'** on arm **159** which is pivoted on the carriage at **150²**. Arm **159** at the end remote from its pivot **150²** is pivotally connected by link **159'** to the armature of solenoid **160**. It will be evident that when the solenoid is energized, the position of toggle pivot **150'** changes so as to move the cutter to a lower depth from that which it will attain when solenoid **160** is not energized. The solenoid **160** will be energized by a pattern control as later described. Force to move to the upper or higher cutting position and to the non-cutting position is provided by leaf or wire spring **145**. FIGURE 45*a* shows the solenoid in the energized position.

The pin **153** is adjustable vertically so as to provide an adjustment for the stop position of the toggle **148** and also the extended stop position of the link **159'**.

In FIGURE 46 I illustrate a modification of the device of the invention, in which the float cutter arm **142** is biased toward retraction, and is moved into operative position to selectively cut from above at intervals along the length of the float row or in selected float rows by a solenoid **160'** mounted on the cutter carriage and having an armature **161** pivotally connected to a link **162** which is pivotally connected to the knife arm.

The solenoids receive power from an electric power source **163** and have a switch **164** in the circuit which is opened and closed by a cam track (not shown) in response to the pattern, the cam track suitably being a face cam along the path of the wire motion if it is desired to cut from above at different positions across the width of the fabric repetitively, or being a switching drum (as in MacCaffray U.S. Patent No. 2,932,181) as well known in the art, coordinated to the operation of the loom, to control the solenoids.

Where it is desired merely to cut from above in certain rows and not in other float rows, the mechanism of FIGURE 47 is suitable. This is a modification of the bumper mechanism **155** of FIGURE 41. In this case the plunger **155** is pivotally connected at **165** to a lever **166** which is pivoted intermediate its ends at **167** to the bracket **131** at the wire motion side of the loom and is pivotally connected at **168** at its opposite end to armature **170** of solenoid **171**. The circuit of the solenoid receives electric power **163** and has a switch **164** which in the simplest embodiment may be open during the movement of the cutter across one float row and closed during the movement of the cutter across another float row, as for example by actuation from the treadle cam (not shown) which turns once for every two rows of weaving. Where a more complicated sequence is desired, a pattern control drum as mentioned above may be used to operate the switch **164**. Thus, when the solenoid is energized, the bumper **155** moves into operative position so as to trip the off-center toggle lever against its stop pin **153** and thus move the cutter into cutting position for the cutting of the next float row and when the solenoid is deenergized helical compression spring **172** acting on the bumper retracts the bumper so that it does not operate to depress the cutter arm **142** for the next float row.

While the float cutter has been shown cutting in one direction of motion across the fabric, it will of course be understood that it can be built to operate in the reverse direction, if desired.

When cutting from above float loops which are arranged on the sloping portions of wavy pile wires, it is desirable to use a steeper cutting angle than in the case of float loops over straight pile wires or horizontal portions of two or more wavy pile wires, and I illustrate in FIGURE 48 a cutter arm **142'** which can be substituted for the cutter arm **142** in FIGURES 44, 45, 45*a* and 46, and which has the cutter **144** disposed at an angle of about 30° with respect to the horizontal when in operative position. If the float cutter of FIGURE 48 is not used in this case, there is a tendency for the knife to jump or fail to make a clean cut while approaching high portions of a wavy wire.

In some cases there may be a tendency for the float cutter to jump from one row to another, especially when cutting from above between wavy pile wires which have extremely low portions. In FIGURE 49 I illustrate in

retracted position a cutter arm 142^2 which has an elongated trailing shoe 143' which is longer than the low portion of the wavy pile wires in profile and rides down near the bottom of the pile wires and prevents jumping from one float row to the next in cutting from above.

In some cases it is desirable to use a rotary float cutter rather than a straight knife, and in FIGURE 50 I illustrate a rotary float cutter 173 turning on a shaft 174 and preferably having a fluted wedge-shaped cross-sectional cutting edge 175. The edge of the rotary cutter preferably travels at a slow speed of the order of magnitude of the speed of progression of the cutter carriage.

In manipulating the rotary cutter to cut to varying depths at different points across the fabric, it is preferable to have the rotary cutter move substantially straight up and down so that it is not likely to partially cut float loops.

In FIGURE 51 and 52 I illustrate fabrics which have been produced according to the principles of the invention.

FIGURE 51 shows a pile fabric woven over straight noncutting transverse pile wires, seven wires per inch of carpet, 216 pitch, with a pile wire height of 0.323 inch. The pile is all wool and shows cut and uncut areas, the cut areas being floats cut from above.

FIGURE 52 shows the face of a fabric according to the invention woven over straight noncutting pile wires, seven wires per inch of fabric, 216 pitch with a wire height of 0.323 inch. The face is also wool yarn and exhibits a background of uncut loops and cut high float tufts cut from above. The areas of uncut loops are larger in this case than in FIGURE 51.

It will be evident that with two or more different pile frames, the yarn of the different frames may be of different character including color, weight, construction or materials.

It will be evident that it is important that the cutter from above should not engage and hang up upon the top of a pile wire, but in the preferred embodiment should be moved down between two wires where it can be guided by such wires. This is particularly desirable in a transverse pile wire loom.

FIGURES 53, 54 and 55 show a modified form of transverse pile wire which is desirably employed for the initial entrance of the cutter with cutting from above. In this case the straight body of the wire 108 at the point where it is within the fabric has a relatively wide or rounded top 188 as best seen in FIGURE 55, the sides of the wire being effectively parallel clear to the top, but at points beyond the fabric adjoining the head 107 the wire cross section is reduced in thickness at 190 as best seen in FIGURE 54. This reduces the possibility that the cutter can encounter and hang up against the top of the wire. It also assists in moving the cutter down between two wires even in weaving nine wires per inch, since the wires at that point are not woven into the fabric, and therefore have more lateral flexibility. Once the cutter moves down between the wires at the position where the wires are beyond the fabric, the wires serve to guide the cutter as it moves transversely across the loom, and thus assure that the cutter will follow the desired position relative to the float loops in the fabric. The cutter can be inserted between the wires at the end remote from the head beyond the fabric.

In view of my invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the method, fabric and loom shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. The method of weaving a pile fabric, using a set of transverse pile wires, which comprises interweaving together a fabric backing of warp and weft yarn ends including pile binding weft ends, with warp pile yarn ends having legs bound beneath the binding weft ends, said warp pile yarn ends forming the face of the fabric, in weaving raising at least some of the pile yarn ends over a plurality of transversely inserted pile wires and above at least one binding weft yarn end to form multiple pile wire high floats and binding in the legs of said multiple pile wire high floats beneath binding weft yarn ends on outer sides of the pile wires which are under the ends of said floats, weaving the pile wires into the fabric, while the pile wires are woven in the fabric cutting from above at least some of said multiple wire high floats at a position over the space between the wires which are under the ends of said high floats and substantially transverse to the tops of said high floats to form cut pile tufts, and subsequently removing the pile wires from the fabric.

2. The method of claim 1, which comprises cutting from above said multiple pile wire high floats at the middle thereof.

3. The method of claim 1, which comprises raising said high floats to be cut from above over only two pile wires.

4. The method of claim 1, which comprises raising said high floats to be cut from above over more than two pile wires.

5. The method of claim 1, which comprises cutting from above said high floats by running the cutter down between two pile wires and guiding the cutter by the two pile wires.

6. The method of claim 1, which comprises also raising pile yarn ends over single pile wires to form single pile wire loops and cutting said multiple pile wire high floats from above without cutting said single pile wire loops.

7. The method of claim 6, which comprises binding said single pile wire loops beneath adjoining binding weft yarn ends.

8. The method of claim 6, which comprises binding the legs of said single pile wire loops beneath spaced binding weft yarn ends while floating said single pile wire loops over at least one intervening binding weft yarn end.

9. The method of claim 6, which comprises forming cut pile which is higher than said single pile wire loops in the same fabric.

10. The method of claim 1, which comprises cutting from above said multiple pile wire high floats at a position which is intermediate between the first and last inserted wires of the wire set.

11. The method of claim 1, which comprises weaving said high floats in staggered relation from two sets of pile yarn ends.

12. The method of claim 11, which comprises tying in the pile wires by single wire loops at intervals throughout the fabric.

13. The method of claim 11, which comprises cutting from above said staggered multiple pile wire high floats selectively and leaving others uncut.

14. The method of claim 11, which comprises weaving said staggered multiple pile wire high floats over wavy pile wires so that the tufts produced after cutting from above are selectively of different heights.

15. The method of claim 1, which comprises weaving said multiple pile wire high floats over wavy noncutting pile wires, and forming single pile wire loops over high portions only of said wavy wires, so as to retain single pile wire loops after separation of the wires from the fabric which have a height determined by the individual wire without robbing from other pile projections.

16. The method of claim 1, which comprises weaving said multiple pile wire high floats over wavy pile wires having cutters at the ends remote from the head beyond the weave, forming single pile wire loops at high portions only of said wavy pile wires, the cutting from above of the floats forming tufts of one height and the removal of the pile wires and cutting of the single pile wire loops producing tufts of a different height whose height is deter-

mined by the height of the individual pile wires without robbing from other pile projections.

17. The method of claim 1, which comprises weaving the multiple pile wire high floats over wavy pile wires at positions of different heights along said pile wires, so that, when said high floats are cut from above, tufts of different height will be produced.

18. The method of claim 1, which comprises weaving said multiple pile wire high floats over straight noncutting transverse pile wires having noncutting spoons at the end thereof remote from the head beyond the weave, producing high pile tufts by cutting said multiple pile wire high floats from above, in an adjoining row forming single pile wire loops over the pile wires from the same pile yarn ends which form said multiple pile wire high floats, and by removing said spoon wires robbing from the tufts adjoining said single pile wire loops to produce tufts of lowered height.

19. The method of claim 1, which comprises floating said multiple pile wire high floats over wires which are of different heights on opposite ends of said high floats, and cutting from above in the middle of the space between the pile wires at opposite end of said floats to produce tufts of unequal lengths.

20. The method of claim 1, which comprises raising the multiple pile wire high floats over pile wires, forming single wire loops over cutting pile wires, and cutting said single pile loops by removing said cutting pile wires from the fabric after the multiple pile wire high floats have been cut from above.

21. The method of claim 20, which comprises raising the single pile wire loops over straight cutting pile wires and thereby producing a background face of uniform pile height in the fabric.

22. The method of claim 20, which comprises raising said single pile wire loops over wavy cutting pile wires and thereby producing a background face of different heights of tufts in the fabric.

23. The method of claim 1, which comprises selectively cutting from above some only of the multiple pile wire high floats according to a pattern.

24. The method of claim 1, which comprises selectively cutting from above some only of the multiple pile wire high floats in a particular row of floats of the fabric according to a pattern.

25. The method of claim 1, which comprises forming multiple pile wire high floats of different heights and cutting from above said multiple pile wire high floats only to a certain fabric depth, leaving other multiple pile wire high floats uncut.

26. The method of claim 1, which comprises forming multiple pile wire high floats of different heights, and cutting from above said multiple pile wire high floats to certain predetermined fabric depths, in accordance with a pattern, leaving other multiple pile wire high floats below such predetermined depths uncut.

27. The method of claim 1, which comprises cutting from above said multiple pile wire high floats only in certain rows of floats in the fabric.

28. The method of claim 1, which comprises also in the weaving floating at least some pile yarn ends over at least one pile binding weft yarn end and binding them beneath pile binding weft yarn ends at the ends of the loops thus formed, said loops extending beneath pile wires, and after weaving cutting from above said float loops beneath the wires at least partially at intermediate points thereof.

29. The method of claim 28, which comprises cutting said float loops beneath the wires merely to the extent of roughing them up.

30. The method of claim 28, which comprises completely cutting from above said float loops under the wires.

31. The method of claim 1, in which said pile fabric is woven with other single wire pile projections in addition to the said multiple wire high floats which comprises cutting from above said multiple pile wire high floats above said other pile projections in the fabric without cutting from above other said pile projections.

32. The method of claim 1, which comprises weaving said multiple wire high floats over transverse pile wires having raised portions, weaving normal pile loops over said wires, and after cutting the floats from above, withdrawing said pile wires one at each course and thereby robbing from the previously formed tufts cut from above.

33. The method of weaving a pile fabric which comprises interweaving together a fabric backing of warp and weft yarn ends including binding weft yarn ends with pile warp yarn ends forming the face of the fabric, in weaving raising at least some of the pile warp yarn ends in the pile over pile wires in certain areas and binding in the legs of the pile loops thus formed beneath binding weft yarn ends, weaving the pile wires in the fabric, in other areas forming low areas from the pile warp yarn ends, in the low areas weaving at least some of the pile yarn ends above pile binding weft yarn ends and binding the loops thus formed at opposite ends beneath pile binding weft yarn ends, and subsequent to the weaving at least partially cutting from above said loops in the low areas transverse to the top of said loops and at a position between two wires.

34. A pile fabric loom including heddles, weft insertion means, and transverse pile wire means adapted to be woven into the fabric, in combination with means operative while the pile wires of the pile wire means are woven into the fabric for cutting from above yarn which extends warpwise across above at least two pile wires of said pile wire means, said cutting means operating at a point intermediate between pile wires which are at the ends of the loop formed by said yarn extending over said pile wires, intermediate between two adjoining pile wires over which said loop extends, and generally transversely to the yarn extending over said wires.

35. A loom of claim 34, in which the means for cutting from above extends down into the space between two pile wires.

36. A loom of claim 34, in combination with a shoe on said means for cutting from above extending below said means and controlling the depth of cutting.

37. A loom of claim 34, in which said pile wire means includes wavy pile wires, in combination with a shoe on said means for cutting from above extending beneath said means for cutting from above and elongated along the length of the pile wires to an extent greater than the length of the low portions of said wavy pile wires.

38. A loom of claim 34, in combination with means for selectively raising and lowering said means for cutting from above.

39. A loom of claim 34, in combination with means for manipulating said means for cutting from above with respect to a fabric formed on the loom, and for moving the means for cutting from above into operative position at one time and out of operative position at another time.

40. A loom of claim 34, in which the pile wires of said wire means have noncutting spoons on the ends remote from the heads, said pile wires being transverse pile wires, in combination with means for moving said means for cutting from above across the loom, and means for advancing said means for cutting from above to cutting position and for retracting said means for cutting from above to noncutting position before said spoons are encountered.

41. A loom of claim 34, in combination with means for selectively moving said means for cutting from above into cutting position and retracting said means for cutting from above out of cutting position at different relative positions during one back and forth transverse reciprocation of relative motion of the means for cutting from above with respect to the fabric.

42 A loom of claim 34, in combination with means for adjusting selectively the depth to which the means for cutting from above advances into the fabric during any

one back and forth transverse reciprocation of cutting-from-above motion.

43. A loom of claim 34, in which said pile wires of said pile wire means are wavy pile wires, in combination with means for maintaining said means for cutting from above at a particular depth at which it will cut some but not all of the yarn extending over more than one of said wavy transverse pile wires.

44. A loom of claim 34, in combination with selective means for rendering said means for cutting from above operative on certain back and forth transverse reciprocations and inoperative on other back and forth transverse reciprocations.

45. A loom of claim 34, said pile wires having bodies which lie within the fabric and have round top portions in cross section, and said pile wires being reduced in thickness beyond the fabric at the top when viewed in cross section in the area where the cutting-from-above means is inserted between pile wires.

46. A loom of claim 45, in which the reduction in thickness in the wire cross section at the top is adjacent the head end.

47. The method of weaving a pile fabric, which comprises interweaving weft ends of yarn with backing warp yarn and pile warp yarn, inserting and weaving in at each course a transverse pile wire which is inserted above the backing warp and weft yarn but under certain selected pile warp yarns, forming face pile loops of the said pile warp yarn by binding the legs of said face pile loops under weft yarn ends, some of said selected pile yarn ends being raised into face float loops over a plurality of said transverse pile wires which are between the said weft binding of the legs of said float loops, inserting a cutter from above into the space between selected pairs of transverse pile wires, moving the cutter longitudinally of the said pair of transverse pile wires and transversely to said float loops over a plurality of pile wires, cutting at least some of the tops of the said face float loops over the space between the wires to form cut pile tufts, and subsequently withdrawing said transverse pile wires from the fabric.

48. The method of forming pile tufts cut from face float loops in a pile fabric having weft yarn interwoven with warp backing yarn and with legs of warp face pile yarn, which comprises forming face pile yarn loops from transverse pile wires with at least some of said face pile yarn loops forming float loops extending warpwise over a plurality of transverse pile wires between the binding points of the legs of said float loops, inserting a cutter between two of said transverse pile wires at a level beneath the tops of said float loops and cutting said float loops to form cut pile tufts by moving said inserted cutter parallel with the said transverse pile wires.

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