Aug. 23, 1955 H. J. SMILEY 2,715,917

METHOD OF WEAVING A PILE FABRIC

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FIG. 1.

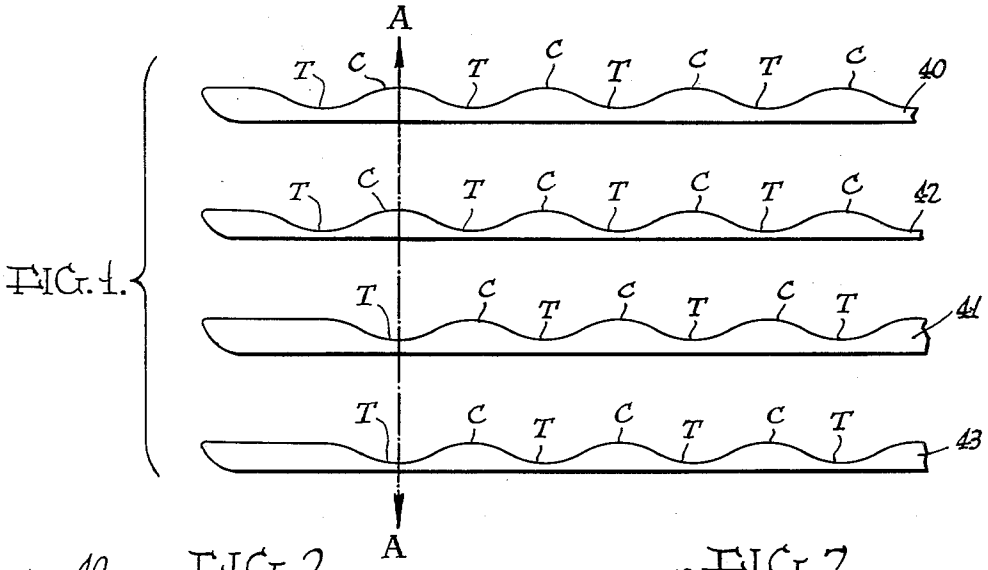


FIG. 2.

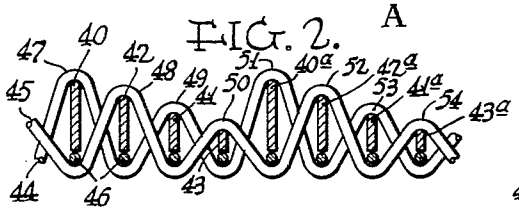


FIG. 3.

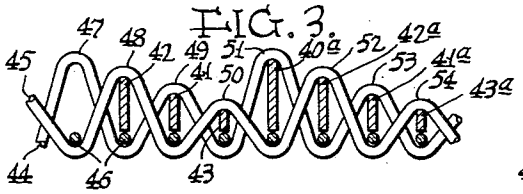


FIG. 4.

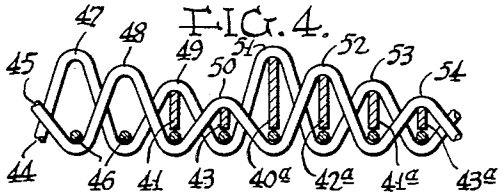


FIG. 5.

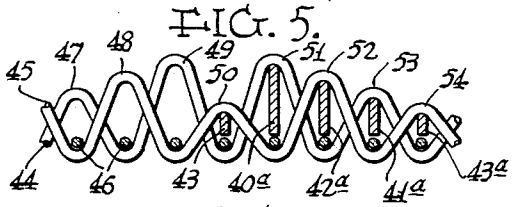


FIG. 6.

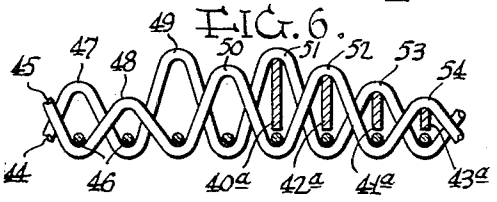


FIG. 7.

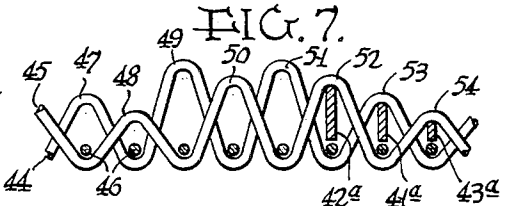


FIG. 8.

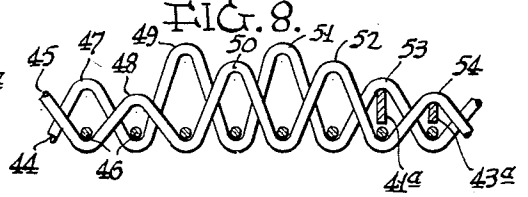


FIG. 9.

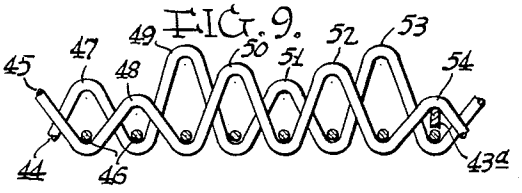
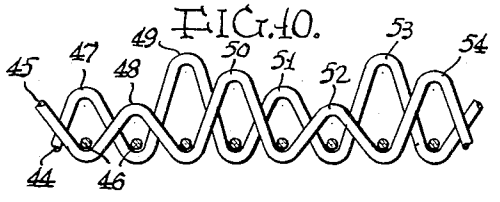


FIG. 10.



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FIG. 11.

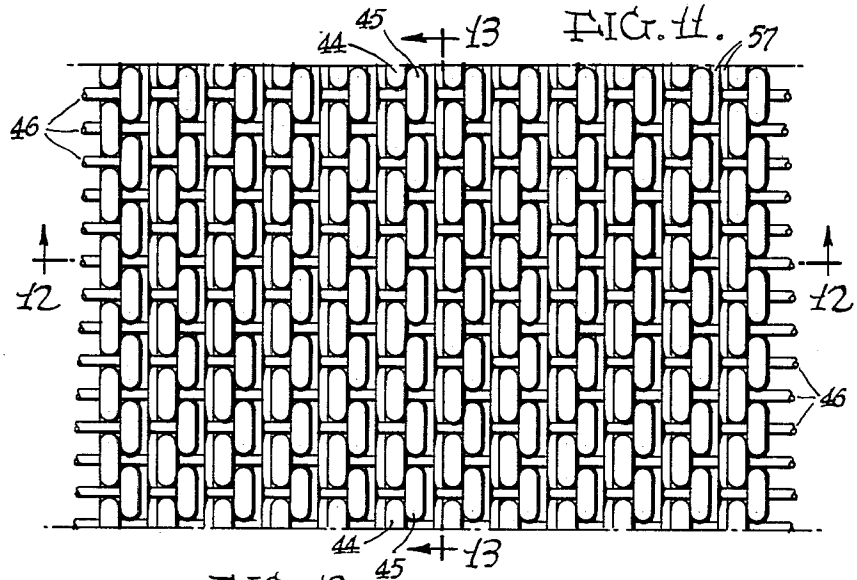
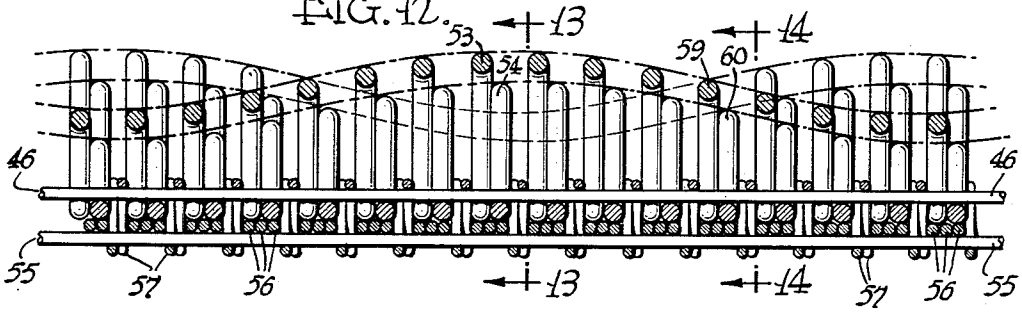


FIG. 12.



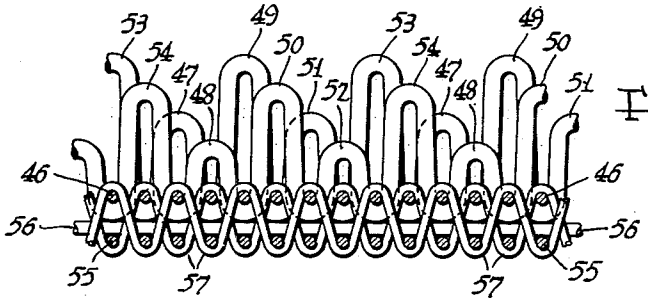
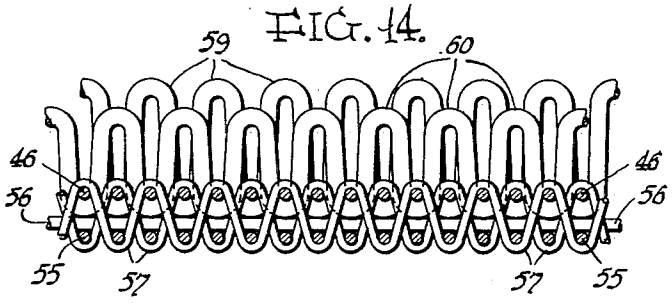


FIG. 13.

FIG. 14.



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FIG. 15.

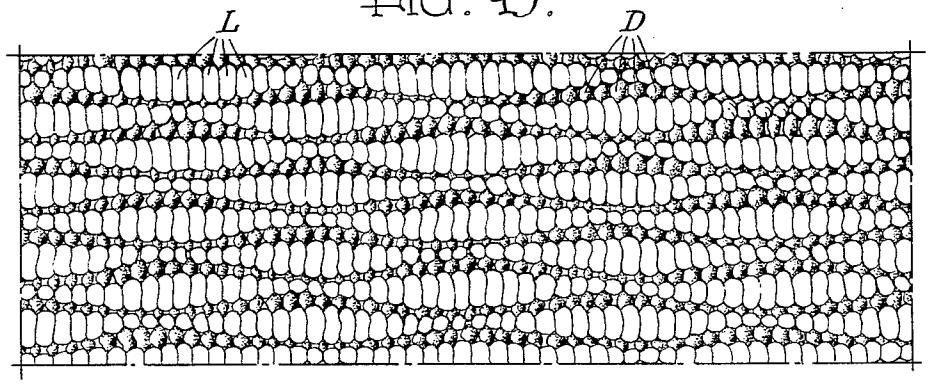


FIG. 16.

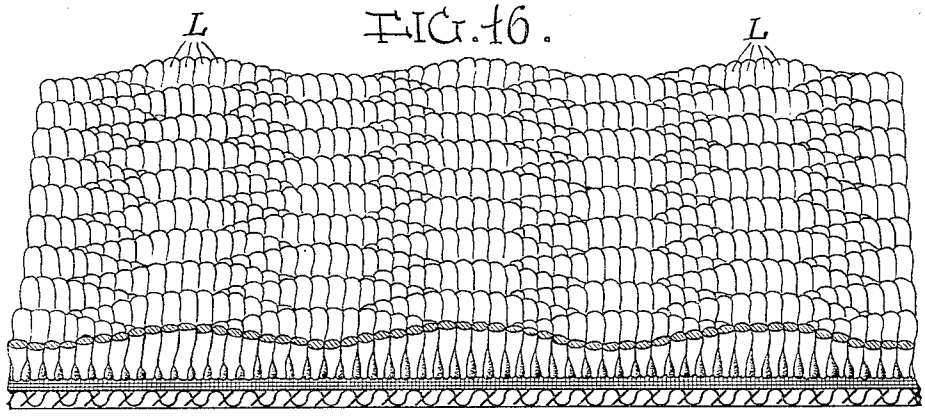
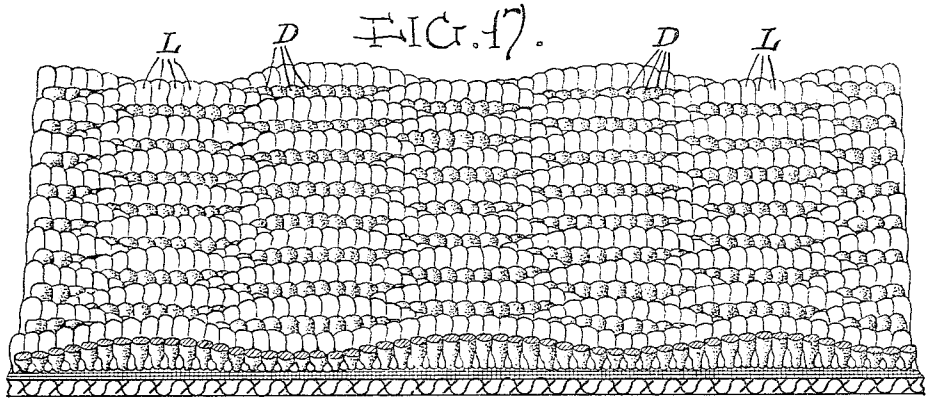


FIG. 17.



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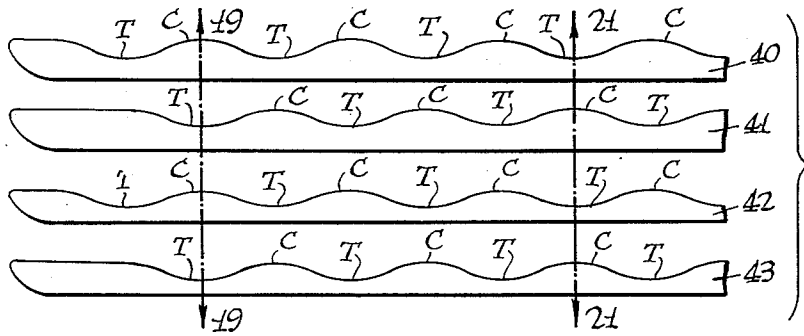


FIG. 18.

FIG. 19.

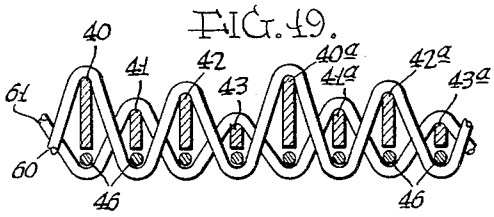


FIG. 21.

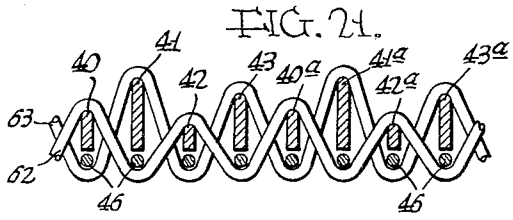


FIG. 20.

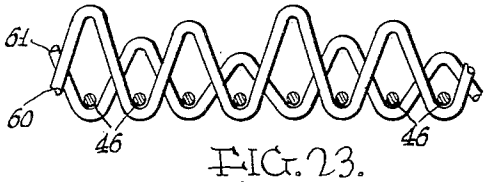


FIG. 22.

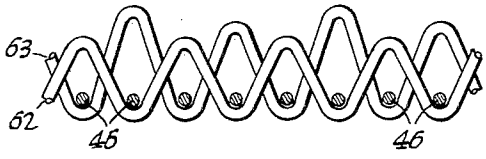


FIG. 23.

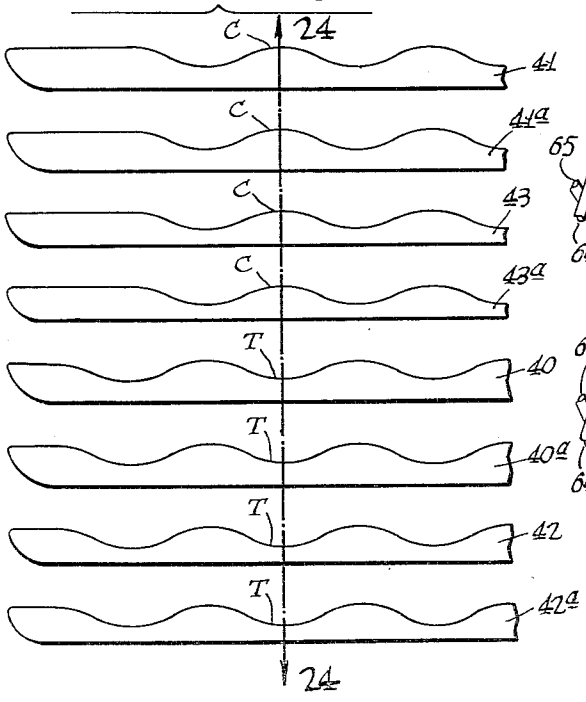


FIG. 24.

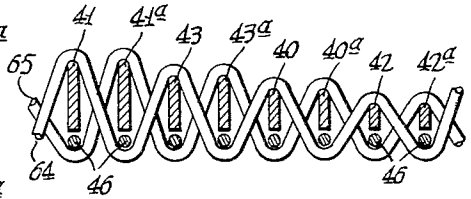
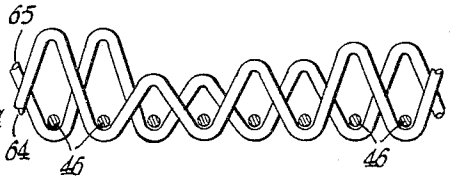


FIG. 25.



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FIG. 27.

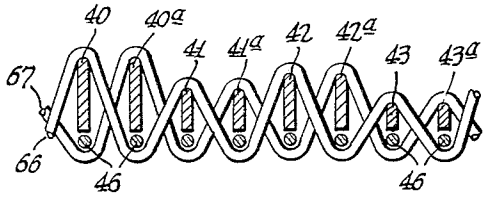


FIG. 29.

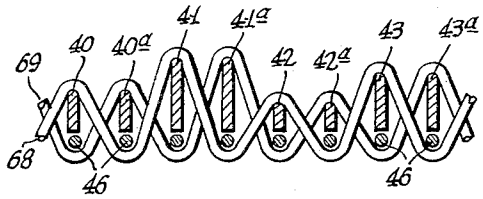


FIG. 28.

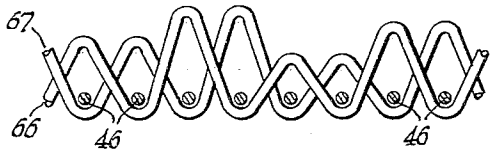
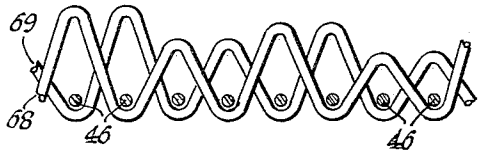


FIG. 30.



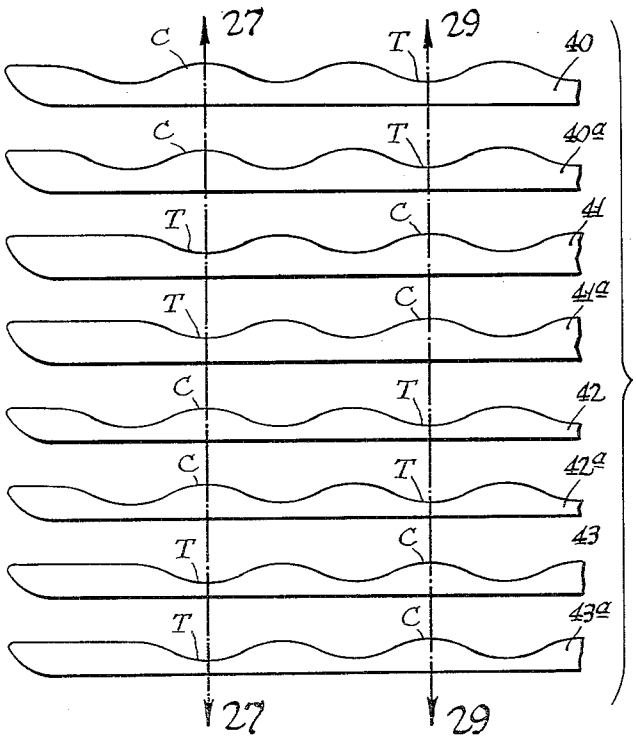


FIG. 26.

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FIG. 32.

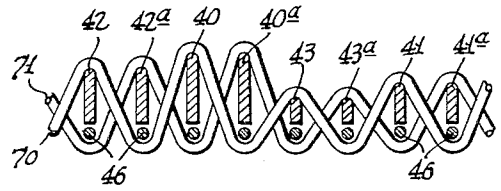


FIG. 34.

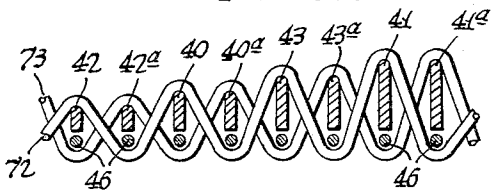


FIG. 33.

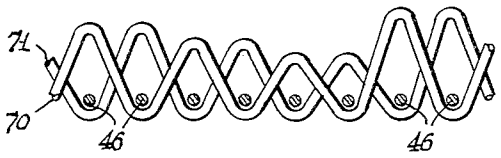
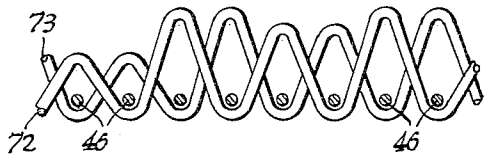


FIG. 35.



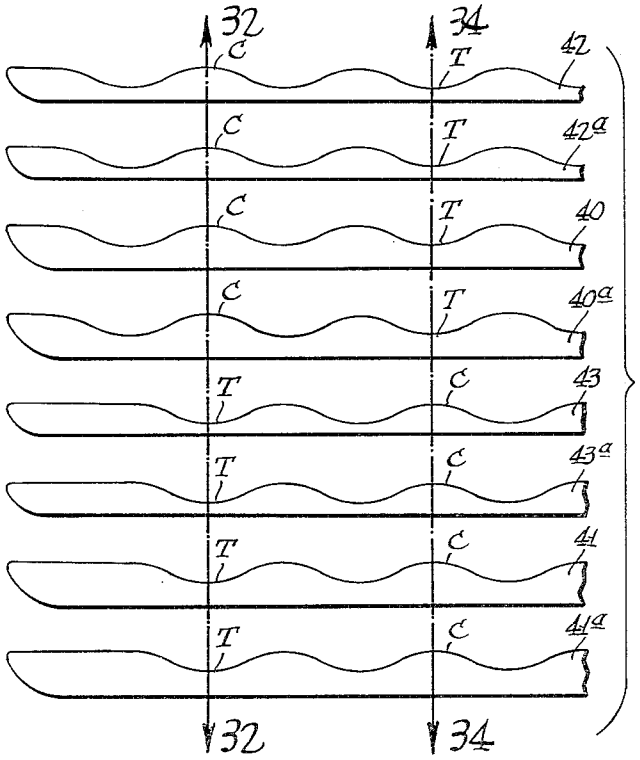


FIG. 31.

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United States Patent Office 2,715,917
Patented Aug. 23, 1955

2,715,917

METHOD OF WEAVING A PILE FABRIC

Harry J. Smiley, Glasgow, Va., assignor to James Lees & Sons Company, Bridgeport, Pa., a corporation of Pennsylvania

Application June 14, 1951, Serial No. 231,455

4 Claims. (Cl. 139—39)

This invention relates to looped pile fabrics having a novel appearance imparted by means of specially arranged sets of serrated pile wires.

I have found that novel and unexpected pattern effects can be achieved in a looped pile fabric when two pile yarns in the same dent which pass under alternate upper weft shots, and preferably of different colors, are woven over serrated or undulating pile wires in which the wires are of different heights and in which the warpwise relation of the crests and troughs on the wires is arranged in accordance with a predetermined pattern.

Preferably, I employ four wires of different heights consecutively arranged together with four similar wires arranged in the same order as the first. With a set of these eight wires, very startling results can be achieved simply by re-arranging the wires in the set in various pairs or sequences.

Due to the fact that each pile yarn is only woven over alternate wires, and also due to the fact that the pile yarns can be of contrasting colors, it is possible to provide a carpet which is of one color when viewed in one direction and which is of another color when viewed in the opposite direction, or in which the two colors may predominate in any desired degree. Furthermore, without any physical alteration in the wires themselves, it is possible to provide one effect in one area of the carpet and a different effect in another area.

A primary object of the invention therefore, is to provide a looped pile fabric characterized by transverse rows of loops of different height in which the loops pass under alternate weft shots so that they overlap weftwise of the fabric.

A further object of the invention is to provide in a looped pile fabric an undulating pattern characterized by a series of graduated high and low loops in the same transverse row and overlapped graduated high and low loops in adjacent rows, each row of loops being of contrasting color.

A further object of the invention is to provide in a looped pile fabric adjacent rows of overlapped pile loops characterterized by graduated high and low loops in the same row. The high loops in each row have a diamond shape when viewed from above, which is enhanced by corresponding lower loops on the two adjacent transverse rows at the area in alignment with the higher loops.

A further object is to provide in a looped pile fabric a wavy appearance when viewed from above, that is characterized by transverse rows of overlapped loops of different height and contrasting color.

Further objects will be apparent from the specification and drawings in which:

Fig. 1 shows a set of four wires used to weave the fabric of the invention;

Figs. 2–10 are schematic sections as would occur at the line A—A of Fig. 1, showing the successive pulling of a set of eight wires using a four wire repeat;

Fig. 11 is a schematic face view of a carpet woven in accordance with Figs. 2–10;

Fig. 12 is a transverse section as seen at **12—12** of Fig. 11;

Fig. 13 is a sectional detail on the line **13—13** of Figs. 11 and 12;

Fig. 14 is a sectional detail as seen at **14—14** of Fig. 12;

Fig. 15 is a face view of the carpet of Fig. 11;

Fig. 16 is a perspective of the carpet shown in Fig. 15, as would be seen looking from the bottom;

Fig. 17 is a perspective of the carpet of Fig. 15, looking in the opposite direction;

Fig. 18 shows the four wires of Fig. 1 arranged in a different sequence to provide a different pattern effect;

Fig. 19 is a schematic section at **19—19** of Fig. 18 with two pile warps woven over the wires;

Fig. 20 shows the pile loops of Fig. 19 after the wires are withdrawn;

Fig. 21 is a schematic section at **21—21** of Fig. 18 with two pile warps woven over the wires;

Fig. 22 shows the loops of Fig. 21 after the wires are withdrawn;

Fig. 23 shows the same eight pile wires used in Figs. 2–10 and Figs. 19–22 but with identical wires arranged in pairs rather than in a four wire repeat;

Fig. 24 is a schematic section at **24—24** of Fig. 23 with two pile warps woven over the wires;

Fig. 25 shows the loops of Fig. 24 after the wires are withdrawn;

Fig. 26 shows the wires of Fig. 23 re-arranged in a different sequence;

Fig. 27 is a schematic section at **27—27** of Fig. 26 with two pile warps woven over the wires;

Fig. 28 shows the loops of Fig. 27 after the wires are withdrawn;

Fig. 29 is a schematic section at **29—29** of Fig. 26 with two pile loops woven over the wires;

Fig. 30 shows the loops of Fig. 29 after the wires are withdrawn;

Fig. 31 shows the wires illustrated in Figs. 23 and 26 arranged in a still different sequence;

Fig. 32 is a schematic section at **32—32** of Fig. 31 with two pile loops woven over the wires;

Fig. 33 shows the loops of Fig. 31 after the wires are withdrawn;

Fig. 34 is a schematic section at 34—34 of Fig. 31 with two pile loops woven over the wires; and

Fig. 35 shows the loops of Fig. 34 after the wires are withdrawn.

The invention comprises essentially the provision of a set of preferably eight pile wires, all of which have waves or serrations on the upper edge thereof. The waves are desirably in the shape of a sine curve but it will be understood that the crests and valleys of the wires may have any suitable transverse spacing or height within the scope of the invention. The four wires shown in Fig. 1 are actually one-half of a complete set of eight wires but the second four are substantial duplicates. These eight wires may be arranged in several different four-wire repeats, in sequences having identical pairs and transposed pairs, etc. It will be understood that while I utilize a set of four different wires, this number is not critical and the total number in a set as well as the number of individual distinct wires, may be changed as desired. It is important however, that the pile warps be woven over only alternate wires and it is desirable but not essential, that the crests and troughs on each single wire be of uniform height. At least two of the wires are preferably formed so that the crests on one wire are in alignment with the troughs on another.

Referring now more particularly to the drawings, Fig. 1 shows the four different forms of serrated or wavy wires which when repeated to form a set of eight wires, are used to weave the fabric of Figs. 15–17. In this set, I use

two high wires **40** and **41**, the tops of which have undulations providing crests, C, C and troughs T, T. It will be observed however, that the displacement of the crests and the troughs forms a wave which is out of phase by 180° with the wave formed by the undulations on wire **40**. Alternately arranged with wires **40** and **41** I use two lower wires **42** and **43** having wavy upper surfaces so arranged that the crests and troughs of wire **42** are in phase with those of wire **40** and the crests and troughs of low wire **43** are in phase with those of high wire **41**. Furthermore, the relative heights of the crests and troughs are such that the crests of high wires **40** and **41** form loops of the maximum height. The crests on wires **42** and **43** form medium high loops, the troughs on wires **40** and **41** form medium low loops, and the troughs on wires **42** and **43** form the lowest loops.

With the wires arranged as shown in Fig. 1, a cross section (as seen at A, A) clearly illustrates the relative height of the crests and troughs on the wires as may be seen in Fig. 2. In this connection, it will be understood that Figs. 2–10 show a repeat set of four wires so that the four wires to the left are those shown in Fig. 1 and the four wires to the right, namely **40***a*, **42***a*, **41***a* and **43***a* are duplicates of wires **40—43**. With eight wires comprising a set and arranged as shown in Fig. 2, they are employed in the usual manner in the wire motion of a pile wire loom. In order to obtain full advantage of this wire set, I also employ two pile yarn ends **44**, **45** in the same dent so that the warp pile yarns are woven under alternate upper weft shots **46**, **46** and likewise over alternate pile wires.

Fig. 3 shows the loops formed by warp yarns **44** and **45** after wire **40** has been withdrawn. In this case, loop **47** remains unchanged in height because it was woven over a crest of the wire **40**. When wire **42** is withdrawn (as shown in Fig. 4), loop **48** likewise is unchanged in height because it too is woven over a crest in the wire **42**. However, then wire **41** is withdrawn (as shown in Fig. 5). The low loop **49** woven over the trough in wire **41** is now raised to clear the crests in this wire. This raising of loop **49** simultaneously draws or pulls down loop **47** to provide sufficient yarn for the higher loop **49**. When wire **43** is withdrawn, the low loop **50** woven over the trough and wire **43** which is the lowest loop of all, is also raised as shown in Fig. 6, simultaneously drawing down loop **48** to the position shown therein, which is somewhat lower than the final height of loop **47**.

The above sequence is repeated when the last four wires are withdrawn (as shown in Figs. 7–10) so that when wire **40***a* is withdrawn, loop **51** remains at its original height. When wire **42***a* is withdrawn, loop **52** likewise remains at its original height but when wire **41***a* is pulled, loop **53** is raised from a medium low (as shown in Fig. 8) to the high (as shown in Fig. 9) in order to clear the crest on wire **41***a*. Then when the last wire **43***a* of the set is pulled, loop **54** is changed from a low loop to a medium high loop, to clear the crests on wire **43***a*.

A comparison of Figs. 2 and 10 shows that the final sequence of the height of the loops at the section A, A is exactly the same as the original sequence of the height of the loops when the wires are in place. However, each loop has been displaced to the right a distance equivalent to the space between two weft shots. This is explained of course, by the fact that the drawing of any one wire does not affect the loops in the preceding transverse row but affects only the loops two rows removed, because each pile yarn is woven only over every other wire. Several rather interesting results are achieved in a fabric woven according to the above-described method and with wires arranged as shown in Figs. 1–10. Figs. 11–17 show clearly the results obtained in a conventional pile fabric or carpet having a plurality of upper weft shots **46**, **46**, lower weft shots **55**, **55**, stuffer warps **56**, **56** between the weft shots, and double binder warps **56**, **56**, all

of which form the ground of the fabric. Figs. 11 and 12 illustrate diagrammatically how the two pile warp yarns are arranged in each dent.

Looking warpwise of the fabric (Fig. 12) each transverse row of loops comprises a series of high and low loops, the height of which correspond to the height of the crests and troughs in wires **40—43**. These loops are evenly graduated in height and vary from the low loops **48** and **52** to the highest loops **49** and **53**.

Warpwise of the fabric, Fig. 13 shows the relationship of the highest and lowest loops at a point where the wires are directly out of phase. Since the wave forms of the tops of the wires are out of phase between wires **41** and **42** for example, there will be one or possibly two warpwise rows of loops **59** and **60**, each loop in the row being of substantially the same height. Fig. 14 illustrates two of such warpwise loop rows taken at the point where the wave form of adjacent wires reverses itself.

In addition to the above effect achieved solely through the different height of loops, further interesting effects are derived when the two warp yarns **44** and **45** are of highly contrasting colors. Fig. 15 shows a fabric woven on the wires described in conjunction with Figs. 1–14 in which the warp yarn **44** having the high and the medium low loops is of a different color from the yarn **45** which has the medium high and low loops. Since the high loops **49** and **53** are both in the same warp yarn, the color of this yarn will predominate and what is more important, the higher loops tend to flatten themselves when the carpet is used because there is relatively less lateral support for the high loops, so that diamond shapes are quite prominent. When this fabric is viewed from one side, the darker loops denoted generally by D, D are hidden behind the overlapped lighter loops L, L so that when viewed from the left in Fig. 10 and as shown in Fig. 16, only the high loops L, L can be seen. This of course, creates the effect that the rug is of a uniform color corresponding to that of the lighter pile warps. However, as the angle of vision increases, the loops of darker pile D, D become visible and when viewed from the opposite direction the colors are substantially evenly balanced, as shown in Fig. 17.

It is to be further noted that the line A, A is taken through a crest on wire **40** but even though the line is taken through a trough on wire **40** and the corresponding trough and crests on wires **42**, **41** and **43**, the identical sequence of the loops is maintained. In some of the variations to be described hereinafter, a different sequence of loops is achieved, depending upon the warpwise section of the fabric.

Fig. 11 illustrates diagrammatically a face view of the carpet and shows each loop held perfectly erect and of the same length and width, the only difference in the loops being their height as shown and previously described in conjunction with Figs. 12–14. Actually however, as soon as the wires are pulled, the high loops do not stand upright but tend to flatten out (as shown in Fig. 15) and this effect is of course, heightened as the carpet is put into service. This gives the appearance of wide loops gradually tapering to narrow loops and creates a diamond shape pattern which in effect transfers the undulating shape of the top edges of the wires to the face of the carpet. A primary reason for this result resides in the overlap of the loops and the phase relationship between the crests and the troughs so that a lateral support for the higher loops is absent, thus permitting them to flatten out and enhance the undulating pattern.

Referring now to Figs. 18–22, an entirely different result can be achieved in a four-wire repeat but having the wires arranged so that the two out-of-phase high wires are side-by-side and the two out-of-phase low wires are side-by-side. Fig. 19 shows the pile yarn woven over a set of eight wires arranged in the sequence **40**, **41**, **42**, and **43**, with a similar repeat of wires **40***a*—**43***a*. A section seen at **19—19** passing through one of the crests

on wire 40 before the wires are withdrawn from the loops, is shown in Fig. 19. These same loops are shown in Fig. 20 after the wires are pulled and it will be noted that yarn 60 has both the high and medium high loops, whereas yarn 61 has all the low loops and medium low loops. This is of course, caused by the loop robbing that takes place when the loops woven in troughs of wires 40, 40*a* and 42, 42*a* are first raised and then lowered, as previously explained. It will thus be apparent that the color of yarn 60 will predominate in this area.

However, a section taken through one of the troughs in wire 40 such as 21—21 gives a quite different result. Fig. 21 shows the pile yarns 62 and 63 woven over the wires before withdrawal and Fig. 22 shows the same yarns after the wires are withdrawn. In this case however, yarn 63 has both the high and medium low loops as before but yarn 62 has only loops of uniform medium low height. The explanation for this result will be apparent when it is appreciated that in Figs. 19–21 yarns 60 and 63 pass over only crests on any wire so that there is no loop drawing whatsoever of these yarns, whereas yarns 61 and 62 are always woven over troughs in each wire, thus these two yarns receive the full loop drawing effect.

Figs. 20 and 22 illustrate what may be termed maximum conditions taken at the crests and troughs. Intermediate loops will of course, provide a blending in the appearance of the fabric because there will be one intermediate yarn in which the loops are all of substantially uniform height, as shown in Fig. 14.

Figs. 23—25 illustrate a different result that can be achieved with the same eight wires when they are arranged in pairs instead of in the four-wire repeat described previously. Fig. 23 shows identical wires 41, 41*a* placed side-by-side, then identical wires 43, 43*a*; 40, 40*a* and 42, 42*a*. In this case the first four wires are all in phase with each other. A section through the crests of wires 41 and 41*a* is shown in Fig. 24, with the pile yarns 64 and 65 over the wires. It will be noted that this sequence provides pairs of gradually descending loops from left to right. When the wires are pulled however, the reverse arrangement in loop heights is provided, as shown in Fig. 25, in which the loops of each pair are of equal height but the height of the pairs increases from left to right. The sequence however, is displaced two shots to the right. In this arrangement, the identical result is achieved if the section is taken through the troughs of wires 41 and 41*a* instead of the crests. The intermediate blending in loop heights is of course, present in this form also.

Fig. 26 shows the paired wires of Fig. 23 arranged in the following order: 40, 40*a*; 41, 41*a*; 42, 42*a*; and 43, 43*a*. In this case the phase relationship of each pair alternates. A section taken at 27—27 through the crests on wires 40 and 40*a* shows the pile yarns 66 and 67 forming a pair of high loops, a pair of medium low loops, a pair of medium high loops, and a pair of low loops. When the wires are withdrawn, the height of each loop is changed (as shown in Fig. 28) so that the first pair of high loops becomes a pair of medium low loops, the second pair of medium low loops becomes high loops, the third pair of medium high loops becomes low loops, and the fourth pair of low loops becomes medium high loops. It is noteworthy however, that a section such as 29—29 through the troughs of wires 40 and 40*a* provides a different sequence for the pairs of loops. Fig. 29 shows pile yarns 68 and 69 forming a first pair of medium low loops, a second pair of high loops, a third pair of low loops, and a fourth pair of medium high loops. When the wires are withdrawn as shown in Fig. 30, these loops are transformed into a first pair of high loops, a second pair of medium low loops, a third pair of medium high loops, and a fourth pair of low loops, thus giving a different sequence of loops from that shown in Fig. 28 in the same fabric.

A still further variation using the same wires is shown in Fig. 31, in which the wires are arranged in the sequence 42, 42*a*; 40, 40*a*; 43, 43*a*; 41, 41*a*. A section 32—32 through the crests of wires 42, 42*a* shows in Fig. 32 the pile yarns 70 and 71 forming a first pair of medium high loops, a second pair of high loops, a third pair of low loops, and a fourth pair of medium low loops. Upon withdrawal of the wires, the height of only the last three pairs of loops is changed to provide a first pair of medium high loops, a second pair of medium low loops, a third pair of low loops, and a fourth pair of high loops. This sequence of loops it will be noted, is just the reverse of the final sequence shown in Fig. 25. However, contrary to the arrangement of Fig. 23, a section 34—34 through the troughs of wires 42, 42*a* provides a totally different sequence. Here the yarns 72 and 73 when woven over the wires, form a first pair of low loops, a second pair of medium low loops, a third pair of medium high loops, and a fourth pair of high loops (Fig. 34). When the wires are withdrawn, the first pair of loops is raised but then drawn down to remain as low loops, the second pair are high loops, the third pair are medium high loops, and the fourth pair are high loops, so that there are no medium low loops at all.

It will be appreciated that the above examples are intended to be illustrative of the unusual results that can be achieved by special arrangements of a set of serrated or waved pile wires. By means of a judicious arrangement of the crests and troughs of the individual wires, the employment of duplicate wires and particularly the weaving of each pile yarn over alternate wires, it will be appreciated that many different effects can be achieved using yarn of the same color or of contrasting colors. It is particularly noteworthy that with no alteration in the wires or in the loom mechanism, fabrics of totally different appearance can be woven.

Having thus described my invention, I claim:

1. A method of weaving pile carpet fabric in a wire loom employing a series of wires at least two of which have symmetrical undulating sinusoidal upper edges provided with crests and troughs thereon, said crests and troughs being out of phase on the two wires, which consists of the steps of arranging the two wires in adjacent relationship in the series, raising pile warps having given physical characteristics over only one of said two wires and raising other pile warps having contrasting physical characteristics over only the other of said two wires.

2. A method of weaving pile carpet fabric in a wire loom employing a series of wires at least two of which have undulating upper edges provided with crests and troughs thereon, the crests and troughs of the first wire being higher than the respective crests and troughs of the second wire, said crests and troughs being aligned warpwise of the loom, which consists of the steps of arranging the two wires in adjacent relationship in the series, raising pile warps having given physical characteristics over only the first wire, and raising other pile warps having contrasting physical characteristics over only the second wire.

3. A method of weaving pile carpet fabric in a wire loom employing at least two pile wires, one of which has an irregular upper edge of a given configuration, and the other which has an upper edge similarly configurated to said given configuration but of lesser height, comprising the steps of arranging the two wires in adjacent relationship, raising pile warps having given characteristics over only one of said two wires, and raising other pile warps having contrasting characteristics over only the other of said two wires.

4. The method of weaving pile carpet fabric in a wire loom employing a series of wires arranged in pairs, the first wire of each pair having a given configuration along its upper edge, and the second wire of said each pair having a configuration similar to the configuration of the first wire but being of lesser height, comprising the steps of

arranging the pairs of wires in consecutive sequence in a pile wire loom, raising pile warps having given physical characteristics over only the first wire of each pair, and raising other pile warps having contrasting physical characteristics over only the other wire of each pair.

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