May 29, 1951 G. E. SCHULZ ET AL 2,555,159

METHOD OF AND APPARATUS FOR WEAVING RELIEF DESIGNS IN PILE SURFACES OF TEXTILE FABRICS

Filed Feb. 4, 1947 4 Sheets-Sheet 1

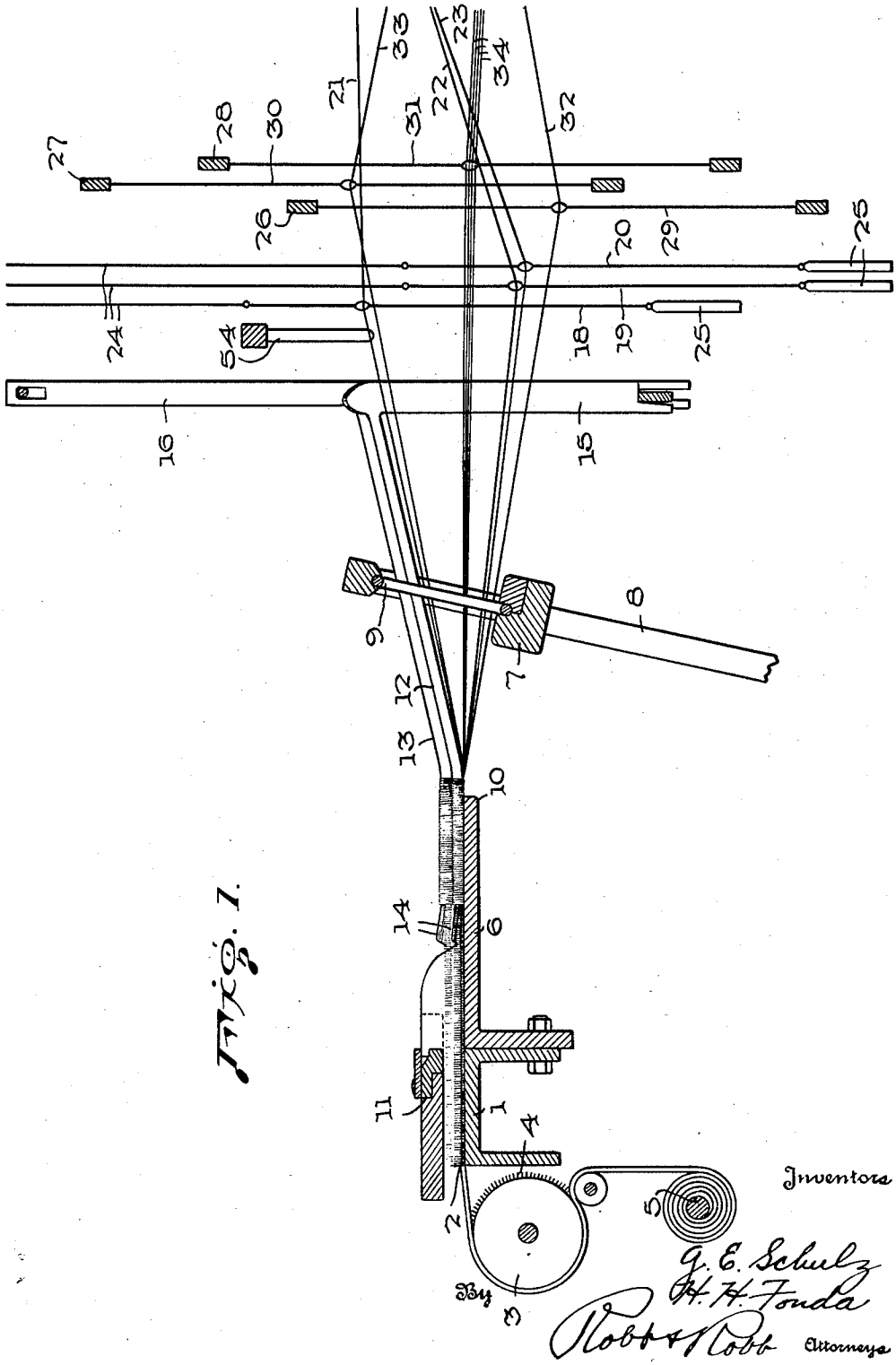


FIG. 1.

Inventors
G. E. Schulz
H. H. Fonda
By Robb & Robb Attorneys

May 29, 1951 G. E. SCHULZ ET AL 2,555,159

METHOD OF AND APPARATUS FOR WEAVING RELIEF DESIGNS IN PILE SURFACES OF TEXTILE FABRICS

Filed Feb. 4, 1947 4 Sheets-Sheet 2

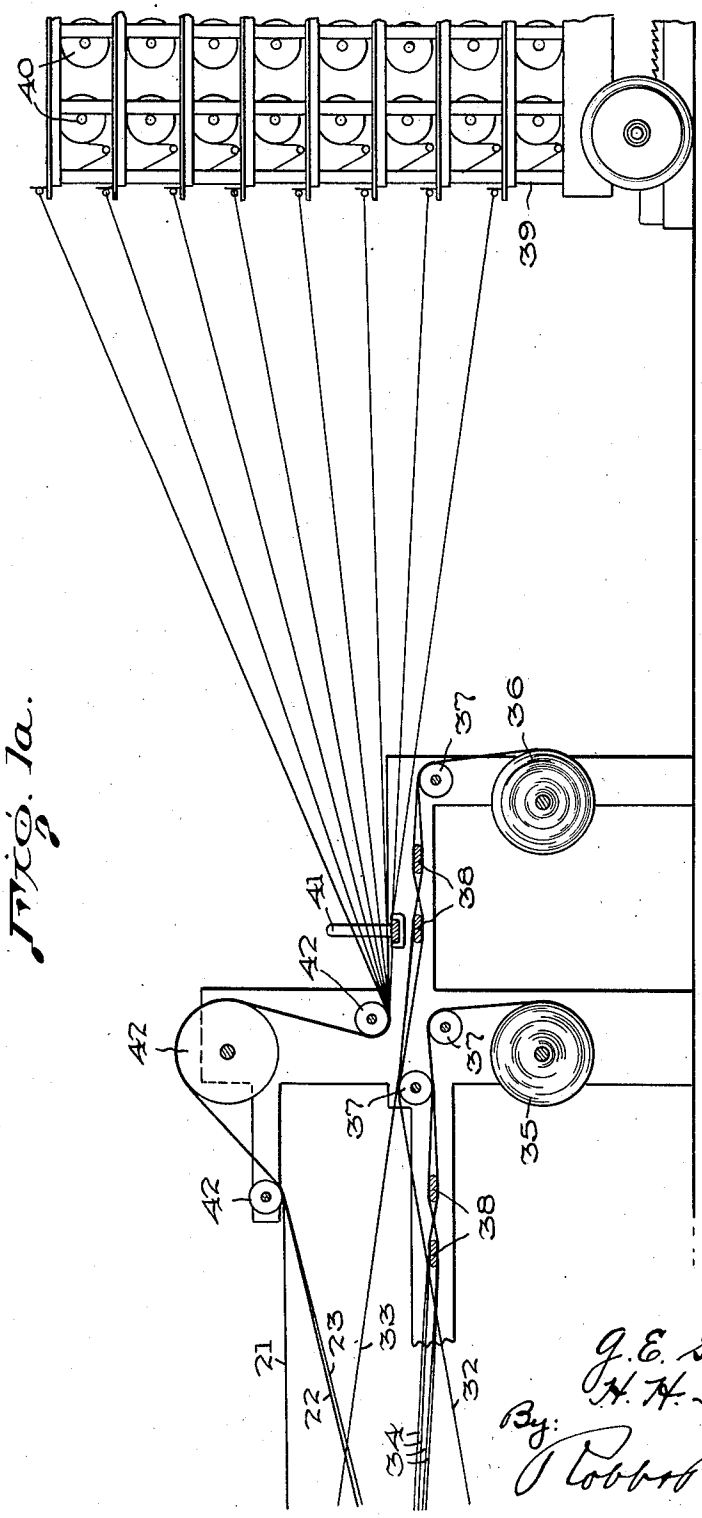


Fig. 1a.

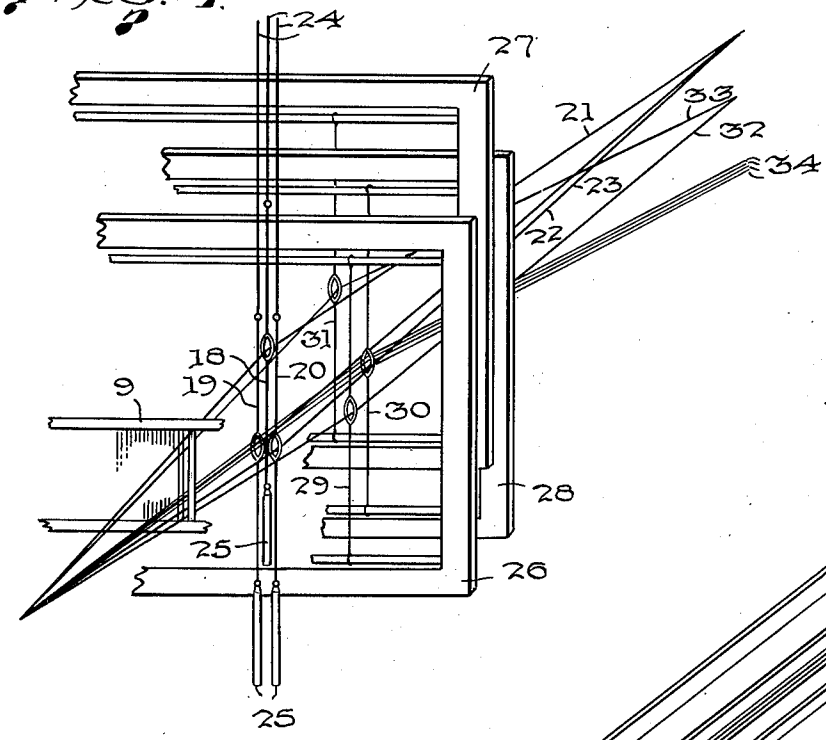
Inventors
G. E. Schulz
H. H. Fonda
By: Robert Robb
Attorneys

May 29, 1951 G. E. SCHULZ ET AL 2,555,159

METHOD OF AND APPARATUS FOR WEAVING RELIEF DESIGNS IN PILE SURFACES OF TEXTILE FABRICS

Filed Feb. 4, 1947 4 Sheets-Sheet 3

FIG. 4.



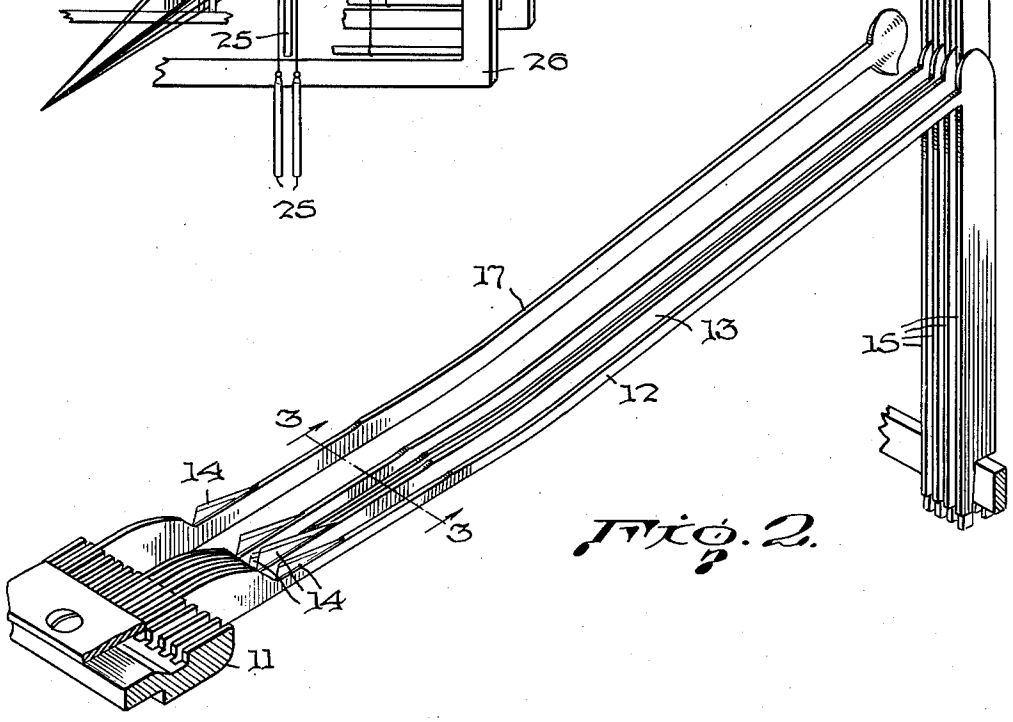
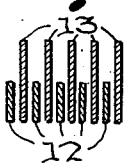


FIG. 2.

FIG. 3.



Inventors
G. E. Schulz
H. H. Fonda
By Robert Cobb
Attorneys

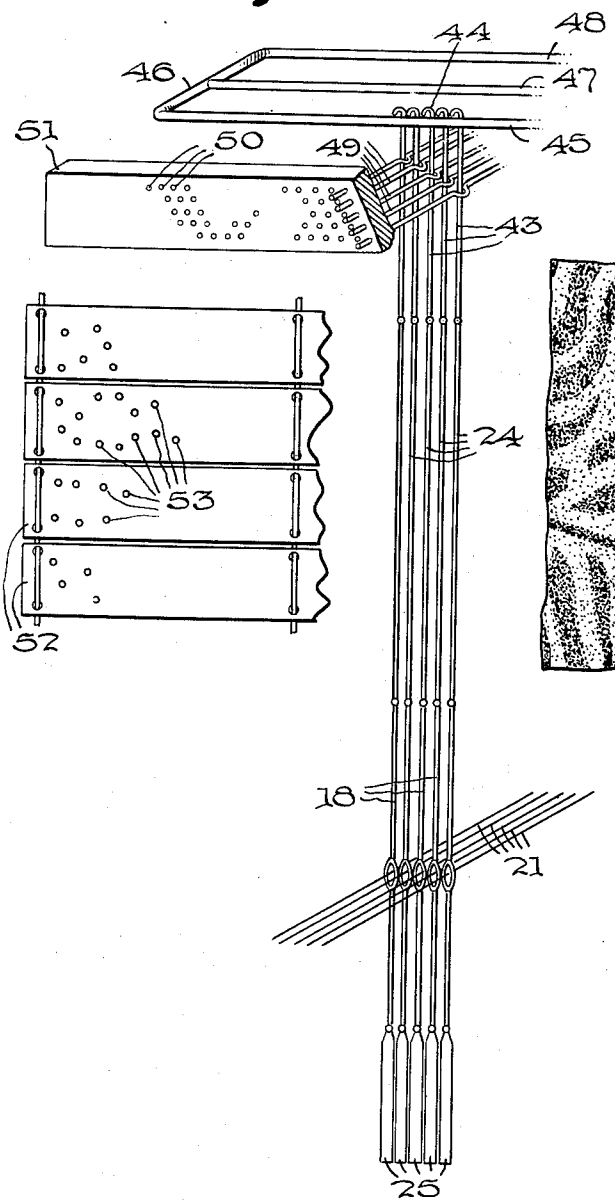
May 29, 1951 G. E. SCHULZ ET AL 2,555,159

METHOD OF AND APPARATUS FOR WEAVING RELIEF DESIGNS IN PILE SURFACES OF TEXTILE FABRICS

Filed Feb. 4, 1947

4 Sheets-Sheet 4

Fig. 5.



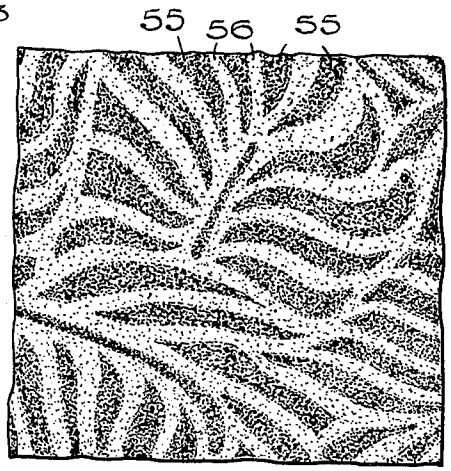


Fig. 6.

Inventors

G. E. Schulz

H. H. Fonda

By Robbins Robb Attorneys

Patented May 29, 1951

2,555,159

UNITED STATES PATENT OFFICE

2,555,159

METHOD OF AND APPARATUS FOR WEAVING RELIEF DESIGNS IN PILE SURFACES OF TEXTILE FABRICS

Gustav E. Schulz, Auburn, and Harold H. Fonda, Skaneateles, N. Y., assignors to Nye-Wait Company, Inc., Auburn, N. Y., a corporation of New York

Application February 4, 1947, Serial No. 726,330

2 Claims. (Cl. 139—47)

1

The present invention relates to a new and improved method of producing pile surfaces of different or contrasting heights in textile fabrics, and to apparatus for creating relief designs, in one or more colors or combinations thereof, in the weaving of textile fabrics such as carpets and rugs.

In Patent No. 2,121,909, granted June 28, 1938, to Harold H. Fonda, there was disclosed an embossed or relief pile fabric of the general type to which the present invention relates, and wherein the embossed or relief effect was attained by the use of two or more sets of pile yarns having different degrees of twist, and partially releasing the twist of the harder twisted yarns by subjecting the yarns to a wetting treatment, so as to cause the pile tufts to elongate and rise above the tufts formed by the lesser twisted yarns. While this method and the fabrics produced thereby are entirely practical and feasible and have been extensively used with very favorable results, the prior method is inherently subject to certain limitations and disadvantages as to range of designs, permissible number of color combinations, physical characteristics of the pile yarns, relatively high cost of production, etc.

Accordingly, the primary objects of the present invention are to provide a new method and apparatus which overcomes the aforesaid limitations and disadvantages, simplifies the attainment of embossed or relief designs of practically infinite variation, reduces the cost of production, is independent of any wetting treatment, makes it unnecessary to employ yarns having a hard or excessive twist, yet is equally applicable to yarns of uniform twist or of any practical range of variation of twist, color, and/or combinations thereof, affords maximum coverage and density, extends the permissible range of variation of two or more different pile heights in the same fabric, and produces a construction and embossed effect which is not affected by cleaning or washing of the fabric.

In carrying out the objects of the invention, the method is characterized by weaving of the fabric on a Wilton loom equipped with a jacquard or other pattern control to control, in predetermined order, the raising and lowering of lingoes through which the pile or surface yarns pass, whereby to form pile loops on stationary pile wires of different heights, the pile loops being ultimately cut and being bound into the backing of the fabric during the weaving of the stuffers, binders, and filling.

2

To permit the practice of this method, there is provided in the loom a set of heddles, lingoes, stuffer warps, binder warps and surface yarns for every split in the reed, as well as a stationary pile wire which extends longitudinally of the loom through each split, the pile wires being arranged in a predetermined order of alternate high and low wires, or other regular sequence of high and low wires, transversely across the loom. As the reed moves back and forth, the surface yarns, binders and stuffers are manipulated up and down by the jacquard and heddle frames which are so timed with relation to each other and the filling shots as to complete a weaving cycle. With the selectivity that is attainable with a jacquard mechanism for controlling the surface yarns, the pile surface of the fabric may be woven so as to produce high and low pile areas in beautiful and exquisite patterns, in one or more colors or combinations thereof, all without the aid of so-called "planted" frames, although planted frames may be employed, if desired, as in the conventional Wilton weave. In the high pile areas, the surface yarns of the color or colors which are not to appear in these areas, may be "buried" in the backing with the stuffers, by not raising these other yarns to form loops over the pile wires, although they may be looped over the low wires which are adjacent to the high wires for these high pile areas, for greater coverage or density, if desired. On the other hand, in the case of the low pile areas, the surface yarns of the color or colors which are not to appear in these low areas, and the surface yarns associated with the adjacent high pile wires, must be buried except where "outlines" are to be formed in the pattern or design.

To offset any loss in density which may result from the use of high and low pile wires, when the surface yarns are buried, it is possible to increase the filling shots per inch to a point that the bulk of materials alone will permit, and by decreasing the size of the filling, the surface yarns can be beaten up to a point of extreme density without any congestion being offered by the stationary pile wires which are disposed in the loom in substantially parallel relation to the surface yarn ends. Since the stationary wires are firmly held in an upright position without having any wire depend upon another for any support, as distinguished from the arrangement in a conventional cross-wire loom, where the cross-wires "float" in the fabric during the weaving operations and mutually depend upon each other for support and there-

fore limit the density to which the yarns may be beaten up because of the thickness of the wires themselves, wires of extremely different heights may be employed for practicing the present invention, resulting in a practically unlimited variation in pile heights between the highest and lowest tufts, and making it possible to obtain more than two pile heights, if desired, and relatively less difficult to obtain either a soft or firm, high pile.

Other and further objects and advantages of the invention will be hereinafter described and the novel features thereof defined in the appended claims.

In the drawings:

Figure 1 is a more or less diagrammatic view, partly in longitudinal vertical section and partly in elevation, of the forward portion of a loom as set up for the practice of the present invention;

Figure 1*a* is a continuation of Figure 1, showing the rear portion of the loom and one of the creels from which the surface yarns are led into the loom;

Figure 2 is an enlarged fragmentary perspective view showing a group of stationary longitudinally extended pile wires, with the pile wires arranged in an alternate high and low wire arrangement transversely of the loom, as in one typical set-up for the practice of the present invention;

Figure 3 is a transverse vertical sectional view taken through the pile wires on the line 3—3 of Figure 2, and more clearly showing the alternate high and low arrangement of the wires;

Figure 4 is a fragmentary perspective view showing the relation of the lingoes and heddle frames for controlling one complete set of warps for one split in the reed, it being understood that a separate set of warps is provided for each reed split, and in the three-frame Wilton loom example illustrated, there being two binder warps, four stuffer warps and three surface yarns of one or more colors, per set, or per split;

Figure 5 is a fragmentary diagrammatic perspective view of the jacquard mechanism for controlling the lingoes through which the surface yarns pass; and

Figure 6 is a fragmentary top plan view of a pile fabric as produced by the present invention, and illustrating the distinctive embossed or relief effect in one typical geometrical or figure design of the many artistic designs which may be produced by the method and apparatus of this invention.

Like reference characters designate corresponding parts in the several figures of the drawings which show only the essential parts of that much of the loom as are sufficient to enable those skilled in the art to understand the construction and operation of the same, and the practice of the method which forms a part of the present invention. The apparatus is illustrated more or less diagrammatically, and, in general, conforms to that of the well-known type of Wilton loom as more particularly described in our prior Patent No. 2,414,064, granted January 7, 1947, except that the stationary pile wires are of two or more heights, and, in addition to the heddle frames, the loom is provided with lingoes through which the pile or surface yarns pass and which are manipulated in an upward and downward direction under the control of a jacquard or other suitable pattern control.

According to the drawings which form a part hereof, 1 generally denotes a portion of the loom frame at the breast or front end of the loom, and upon which the woven pile fabric 2 is supported and over which the fabric passes to the take-up roll 3 which is provided with pins 4 in the usual manner to positively engage the fabric. From the take-up roll 3, the fabric is guided to the winding roll or shaft 5 on which the fabric is wound as it is woven. At the rearward side of the frame member 1 is attached a table or shelf 6 which extends transversely across the loom and upon which the fabric is supported at the weaving point.

Disposed rearwardly of the table or shelf 6 is the lay 7 which is carried by lay-sword 8 having the usual reed 9 at the upper end thereof. The lay 7 and reed 9 may be of conventional form and are movable forwardly and rearwardly towards and away from the rearward edge 10 of the shelf or table 6 in a well-known manner, this motion being imparted to the lay-sword 8 and the lay and reed carried thereby, by suitable operating mechanism (not shown).

At the front or breast end of the loom, and extending transversely across the loom is a pile wire holder generally designated 11, said holder including a heavy metal bar which is suitably attached to the frame member 1 in spaced relation to the latter in order to allow the fabric to pass therebeneath to the take-up roll 3, as the fabric is woven. For the details of the pile wire holder, reference may be had to our prior Patent No. 2,414,064 hereinabove referred to, and it will suffice to say for the present application that the holder is provided with a plurality of accurately spaced vertically disposed slots in which are received the respective butt ends of the pile wires which are generally indicated at 12 and 13. The pile wires preferably have the general form as more particularly described in our prior patent above referred to, except that the wires are of different heights according to the present invention, the wires designated 12 being illustrated as low wires, and the wires designated 13 being illustrated as high wires. The actual heights of the respective pile wires may be varied according to the heights of the pile that is to be produced, and the difference in height of the respective sets of high and low wires may also be varied as desired, according to the contrast that is to be made between the high and low pile areas of the finished fabric. While we have shown only two sets of pile wires, that is, a set of high pile wires and a set of low pile wires, it is to be understood that more than two heights may be employed in the same loom to produce pile surfaces of more than two different heights, when desired. In order to avoid confusion and undue complication of the description herein, the method and apparatus of this invention will be primarily confined to the arrangement employing only two different heights of pile wires, for illustrative purposes.

It will be understood from reference to the drawings that the pile wires are stationary and extend longitudinally of the loom in substantially parallel relation to each other and approximately parallel to the warps of the loom. By the use of the special holder 11, previously referred to, the pile wires are firmly held in vertical positions in accurately spaced relation to each other and do not depend upon each other for support and/or spacing, as in the case of conventional cross-wire looms where the cross-wires float in the fabric during the weaving operations.

Near the forward or butt ends of the respec-

tive pile wires, each wire is provided with a knife 14, when it is desired to cut the pile loops formed on the wires so that the pile surfaces will be formed by the cut ends of the pile tufts which will be woven into the fabric. In any event, there is one pile wire for each split in the reed 9 or pitch count of the fabric, the wires extending rearwardly from the holder 11 through the respective splits in the reed 9, and each terminating in a vertical leg 15. Between each pair of pile wires, there is disposed a separator 16, said separators being suitably supported in a vertical position and arranged in a transverse row coinciding with the transverse row of vertical legs 15 at the rear ends of the pile wires.

In arranging the pile wires in the loom, they may be disposed in a predetermined order of alternate high and low wires transversely across the loom, as best shown in Figure 3 of the drawings. In such a case, starting with a high wire, the high wire will extend through one split in the reed 9, a low wire will extend through the next split in the reed, then another high wire through the next split, a low wire through the next split, and so on, all the way across the loom, until there are sufficient wires as may be required for the width of the fabric that is to be produced on the loom. At the extreme opposite sides of the loom, the wires preferably have the form of selvage wires, one of which is illustrated in Figure 2 of the drawings, as indicated at 17. The function of these selvage wires is well-known in the art, and hence need not be further described.

In back of the pile wires and suitably spaced therefrom is a plurality of lingoes respectively designated 18, 19 and 20, said lingoes each having an eye therein through which the surface yarns are passed, and the lingoes being preferably arranged in one or more transverse rows across the loom. In the set-up, as illustrated by way of example in the drawings, three separate sets of lingoes have been shown, and it will be understood that there is one lingo in each row for every split in the reed 9. If desired, all of the lingoes of the same row may contain surface yarns of the same color, and the surface yarns may be of different colors for the lingoes of the respective rows, there being a surface yarn of each color in every split of the reed. On the other hand, if preferred, the surface yarns may be "planted" so as to have different colors in the same row. To avoid confusion, it may be assumed that in the arrangement as illustrated in the drawings, the respective rows of lingoes designated 18, 19 and 20 contain surface yarns of different colors, said surface yarns being respectively designated 21, 22 and 23. Each lingo in each row is connected at its upper end to a cord 24 known as a harness, and the cords lead upwardly to the jacquard mechanism shown in Figure 5 of the drawings, which will hereinafter be more fully described. The bottom end of each lingo is connected to a weight 25, said weights serving to hold the lingoes in a vertical position and tending to pull the same in a downward direction.

Behind the lingoes is disposed a plurality of heddle frames, respectively designated 26, 27 and 28, said heddle frames respectively supporting the heddles designated 29, 30 and 31. The number of heddle frames may be varied as desired, but for purposes of illustration of the present invention, the set-up as shown in the drawings corresponds to the usual arrangement for a three-frame Wilton loom. Each of the heddles 29 in the heddle frame 26 carries a binder warp, said binder warps being designated 32. Each of the heddles 30 of the heddle frame 27 also carries a binder warp 33. Each of the heddles 31 of the heddle frame 28 carries one or more stuffer warps, said stuffer warps being designated 34, and in the case illustrated, there being four stuffer warps per heddle.

As best shown in Figure 1*a* of the drawings, the stuffer warps 34 lead forwardly through the loom from a stuffer beam 35, or other source of supply, at the back of the loom, and the binder warps 32 and 33 also lead forwardly through the loom from a binder beam 36, or other suitable source of supply, at the back of the loom. Both the stuffer warps and the binder warps pass over one or more guide rolls 37 and lease rods 38 located between the beams and the heddles to guide the warps to the respective heddles and to minimize tangling of the warps.

The surface yarns 21, 22 and 23 are led forwardly through the loom from a suitable source of supply at the back of the loom, such as one or more stationary or portable creels. In Figure 1*a* of the drawings, there is shown a portable type of creel, designated 39, which forms the subject matter of a prior application Serial No. 607,179, filed July 26, 1945, now Patent No. 2,437,670, issued March 2, 1948. It is to be understood, however, that the present invention is not confined to use with creels of this specific type, but when such creels are used, they have the advantage that they can be loaded at a central preparation point and delivered to the loom, or quickly moved from one loom to another, all filled, with the yarns threaded through the usual tensions and guides and ready to be tied to the ends in the loom, thereby minimizing time lost in the operation of the loom. The individual yarn packages or spools are loaded in the creel in rows as indicated at 40, and all of the yarn packages or spools of surface yarns may be either of one color in the same creel, or the colors may be "planted," as preferred. The number of yarn packages, and the number of creels for a given loom set-up may be varied to suit the requirements for the fabric to be woven, there being one yarn package or spool for each surface yarn or end that is to be led through the loom.

From the creel 39, the surface yarns or ends 21, 22 and 23 are led forwardly to the loom and passed through an inverted open reed 41 at the back of the loom. From the open reed 41 the surface yarns may be passed over idler rolls, generally designated at 42. From the idler rolls 42, the surface yarns pass forwardly to the lingoes 18, 19 and 20 which are movable in an upward and downward direction under the control of a suitable pattern control mechanism or jacquard as illustrated in Figure 5 of the drawings.

The jacquard may be of any suitable type, and it is to be understood that the construction shown in Figure 5 is largely diagrammatic and illustrative of one conventional construction which is well-known in the art, and which may be briefly described as follows. The upper end of each cord or harness 24 for the lingoes 18, 19 and 20, is connected to the lower end of a wire 43 which terminates at its upper end in the form of a hook 44. The hooks 44 of the wires 43 which are connected to the lingoes 18, are normally engaged over a bar 45 of a frame 46 which is movable in an upward and downward direction by any suitable motion transmitting mechanism. In a similar manner, the other

rows of lingoes designated 19 and 20 are likewise connected to additional wires having hooks at their upper ends which normally engage over bars 47 and 48 respectively, also carried by the frame 46. Extending forwardly from each wire 43 is a pin 49 which projects through an opening 50 in a board 51, said board serving to hold the pins in uniform position. Associated with the board 51 is a series of cards 52 having holes 53 punched therein in a predetermined position to form the pattern of the fabric. Each of the cards 52 determines the pattern for one weaving cycle, and the cards are successively moved into alignment with the board 51 and pressed against the board as the weaving operations progress. When a card 52 is pressed against the board 51, the pins 49 which pass through holes 53 in the card allow the wires 43 to remain in a position with their hooks 44 engaged with the bar 45 of the upwardly and downwardly movable frame 46, so that the lingoes connected with these wires will be raised when the frame 46 is moved upward. Those pins which do not pass through any hole in the card 52, as where the holes are omitted from the card, will be pressed rearwardly, and the corresponding wires 43 will be moved rearwardly to disengage the hooks 44 from the bar 45 of the frame 46, allowing these particular wires 43 and their lingoes to remain stationary when the frame 44 moves upward.

Referring now to Figure 4 of the drawings, there is shown one complete unit or set of warps which all pass through one split in the reed 9, said split containing either a high pile wire 13 or a low pile wire 12, as the case may be. A brief description of one complete weaving cycle will now be given. As shown, one binder designated 33 is in the extreme raised position, and the other binder 32 is in the extreme lowered position. The stuffers 34 (which may be one or more in number) have just started to rise. The position of the binders and stuffers just referred to is determined by the upward and downward movement of the heddle frames 26, 27 and 28, each of which is suitably connected to a harness (not shown), which is actuated by suitable cams or other driving mechanism (not shown) in a well-known manner to impart motion to the heddle frames in timed relation to each other and to the other elements of the loom. One of the surface yarns 21 is also shown in a raised position to cross over the top of the pile wire for the purpose of forming a pile loop on said wire, this crossing over being controlled by a transversely reciprocatable comb 54 (see Fig. 1) which is located at the back of the pile wires, between the pile wires and the lingoes. The function of this comb 54 is more particularly described in our prior patent hereinbefore referred to.

Continuing with reference to Figure 4, it will be seen that the other two surface yarns designated 22 and 23 are being held down in their extreme lowered position so as to be buried in the back of the fabric as "dead frames" along with the stuffers 34. When the warps are all in the respective positions just described, a filling shot is thrown across the loom by means of a shuttle (not shown). This filling shot passes under the raised binder 33 and surface yarn 21, and over the lowered binder 32, stuffers 34 and lowered surface yarns 22 and 23. Immediately following the crossing of the filling shot, the lingo 18 which controls the raised surface yarn 21 lowers to above midway position, under the control of the jacquard, the raised binder 33 also lowers to its extreme low position, the lowered binder 32 raises to its extreme upper position, the surface yarns 22 and 23 both are raised to above midway position, and the stuffers 34 to above midway position. The filling shot is then returned across the loom, and the filling travels under the surface yarns 21, 22 and 23 and also under the raised binder 32 and the stuffers 34, but it passes over the lowered binder 33. On the third shot of filling, the binders 32 and 33 again exchange positions, the stuffers 34 are lowered, and one of the lingoes which is selected by the jacquard raises one of the surface yarns 22 or 23, whereupon the filling shot is made and one weaving cycle is completed, with the warps in a position to start another weaving cycle which is simply a repetition of the cycle just described.

It will be noted that the binders 32 and 33 move upwardly and downwardly to exchange positions in regular step with the filling shots, and serve to bind the various components into the woven fabric. The lingoes select the desired surface yarn which is to appear at the surface of the fabric, according to the pattern determined by the jacquard, and the surface yarn raises to a position to form the pile loop over the pile wire at the correct time in relation to the movement of the other component parts of the loom. The stuffers 34 are raised and lowered periodically so that the filling shots will pass over and under them in an alternate fashion.

The arrangement as above described is repeated for each split of the reed 9, with the reed splits also containing alternate high and low pile wires, or such other regular order or sequence of high and low wires transversely across the loom. As previously mentioned, the surface yarns in the same reed split may be of different colors, and that color or those colors which are not to appear on the surface of the fabric may be buried in the back of the fabric, along with the stuffers, leaving only a single color or any desired combination of colors to appear on the pile surface. The same colors of surface yarns may either be repeated for each split of the reed, or an entirely different set of surface yarn colors may be employed for each different height of wires used, thus multiplying the color selection that is possible. The selectivity may be still further increased by planting the colors in a predetermined order in the creels 39.

The foregoing method and apparatus may be adapted to the production of an infinite number of different patterns or designs, one typical example of which is illustrated in Figure 6 of the drawings, wherein the dark stippled areas 55 represent the high pile areas, and the lighter stippled areas 56 represent the low pile areas. In producing the high pile areas, the surface yarns at the low pile wires which may happen to fall within these areas may be so manipulated as to all be buried in the back of the fabric, along with the stuffers, but if preferred, these surface yarns may be looped over the low pile wires to form low pile tufts which are interspersed with the high pile tufts so as to give a better density. However, this is not essential, as the density can be equally well controlled by suitable selection of yarns, size of filling shots, and the extent to which the fabric is beaten up by the reed. In the low pile areas, on the other hand, the surface yarns associated with the high pile wires must be buried in the back of the fabric, except where outlines may be desired.

The selectivity and quality which is attainable

by the method and apparatus herein described, far exceeds anything which has heretofore been possible by any prior methods or apparatus. The improvements and advantages of the present invention are especially pronounced when compared with the limitations of conventional cross-wire looms and the methods of weaving fabric on such looms.

While the specific details have been herein shown and described, the invention is not confined thereto as changes and alterations may be made without departing from the spirit thereof as defined by the appended claims.

We claim:

1. The method of producing embossed or relief designs in pile fabrics with Wilton looms having a stationary pile wire in every split of the reed and the wires being of at least two different heights and arranged in a predetermined order of alternate high and low wires transversely across the loom, which comprises passing binder, stuffer and surface warps longitudinally through the loom and through every split in the reed, selectively manipulating the warps aforesaid in an upward and downward direction in timed relation to each other and selectively looping the surface warps over the high and low pile wires to form high and low pile loops in a predetermined order in each transverse row across the loom, and passing filling shots in timed relation to the motion of the binder, stuffer and surface warps, transversely across the loom to bind together the component warps of the fabric into a backing having the surface yarns presented on one face thereof in the form of high and low pile areas arranged in a predetermined pattern according to the selective looping of the surface warps over the pile wires.

2. A pile fabric loom for weaving embossed or relief designs in pile fabrics, comprising a lay, a reed carried by said lay and having a plurality of splits arranged in spaced relation to each other transversely across the loom for receiving binder,

stuffer and surface warps adapted to be passed longitudinally through each reed split, a stationary pile wire longitudinally extended through each reed split in substantially parallel relation to the warps aforesaid, said pile wires being of at least two different heights and arranged in a predetermined order of alternate high and low wires transversely across the loom, means for selectively looping in successive transverse rows the surface warps on selected pile wires according to a predetermined pattern, and means for weaving said binder and stuffer warps into a backing fabric and for binding the surface warp loops into the backing fabric as the latter is woven, with the surface warps extending from one face of the backing fabric in the form of pile areas of different heights and pattern as aforesaid.

GUSTAV E. SCHULZ.
HAROLD H. FONDA.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,191,487	Warner	July 18, 1916
2,067,574	Lowrie	Jan. 12, 1937
2,141,152	Kaufman	Dec. 20, 1938
2,164,090	Shuttleworth	June 27, 1939
2,225,452	Jacobsen	Dec. 17, 1940
2,293,010	Rice	Aug. 11, 1942
2,318,080	Keen	May 4, 1943
2,355,789	Faber	Aug. 15, 1944
2,410,764	Uihlein	Nov. 5, 1946
2,414,064	Schulz	Jan. 7, 1947
2,430,559	Dacey	Nov. 11, 1947
2,477,249	Harding	July 26, 1949

FOREIGN PATENTS

Number	Country	Date
273,409	Great Britain	July 6, 1927