May 23, 1939. A. J. GASH 2,159,265

WEAVING AND WEAVING DEVICE

Original Filed Aug. 24, 1937 2 Sheets-Sheet 1

Fig. 1

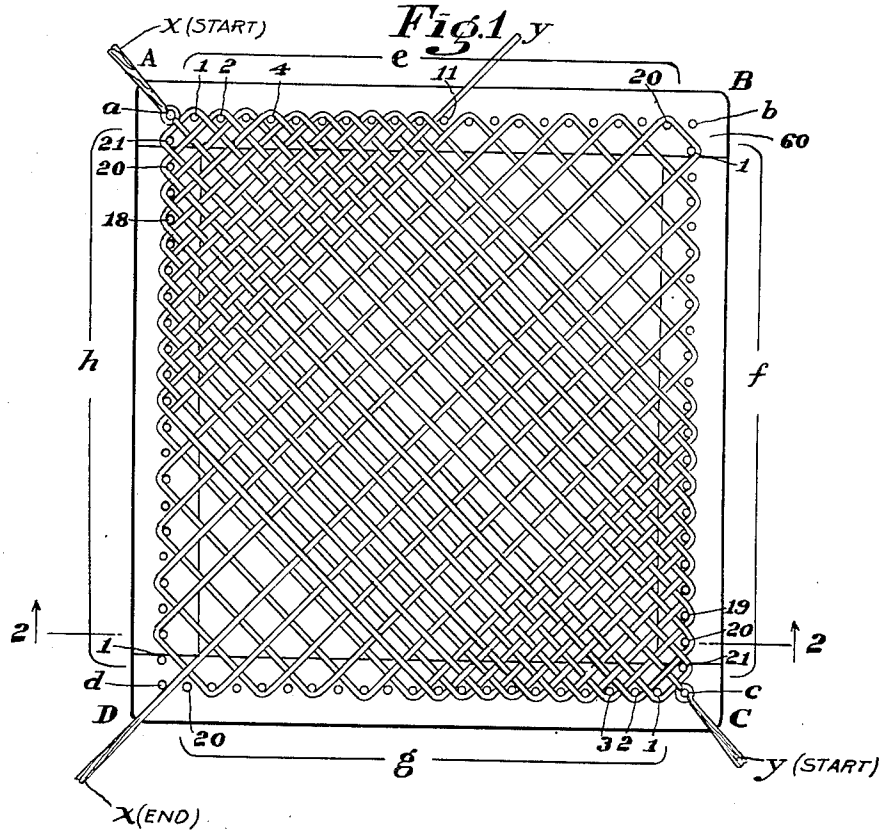


Fig. 2

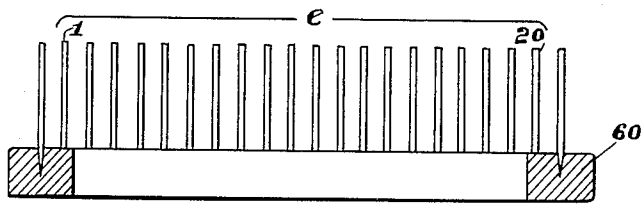
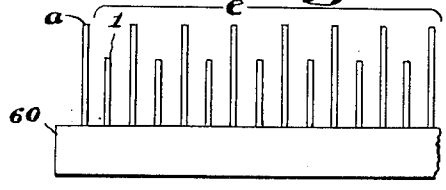


Fig. 3



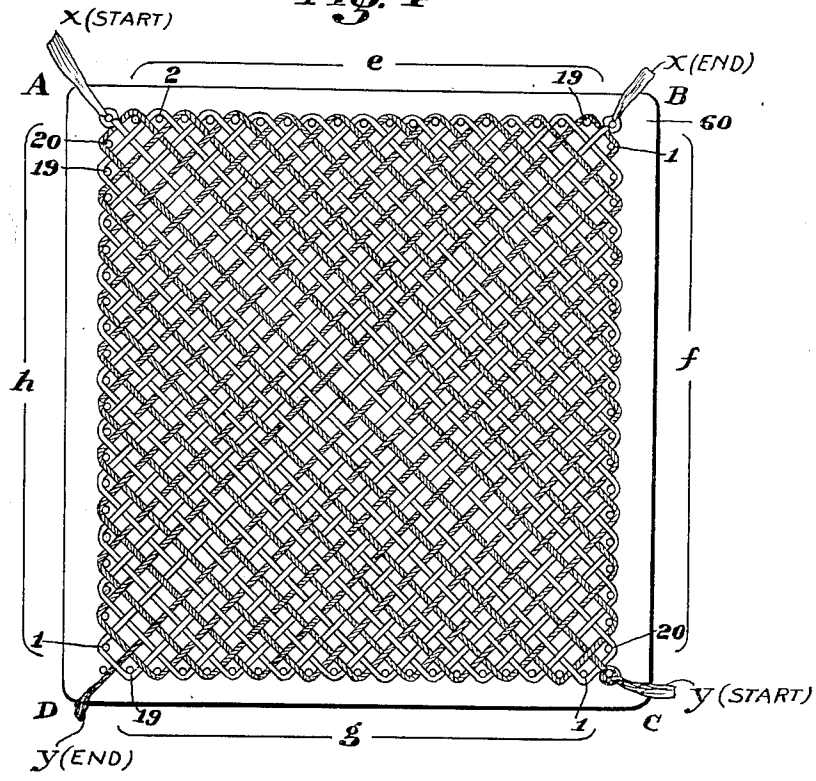
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Fig. 4



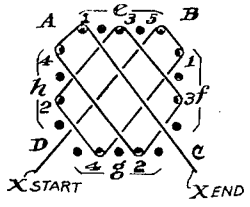


Fig. 5

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UNITED STATES PATENT OFFICE

2,159,265

WEAVING AND WEAVING DEVICE

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Original application August 24, 1937, Serial No. 160,586. Divided and this application September 28, 1938, Serial No. 232,113

8 Claims. (Cl. 139—34)

This invention relates to a strand supporting device and method of using the same, both of which may be utilized in the production of novel bias woven fabrics such as are described and claimed in my prior co-pending application, Serial No. 160,586, filed August 24, 1937, of which this application is a division.

As described in the aforesaid application, one method of making such fabrics comprises a hand manipulation of yarn or similar strand material on a strand-supporting device which is so arranged as to permit ready and easy production of the fabric following simple instructions. It is therefore an object of this invention to provide a strand or the like supporting device, especially adapted for use in weaving such fabrics, preferably by the method described herein.

Further objects and advantages of my invention will be hereinafter referred to in connection with a description of the drawings, in which:

Fig. 1 is a plan of a novel strand supporting device having thereon a partially completed bias woven fabric;

Fig. 2 is an elevation taken on the line **2—2** of the supporting device, but omitting the strands of Fig. 1;

Fig. 3 is a detailed elevation of a modified form of my strand supporting device;

Fig. 4 is a plan of a modified form of my strand supporting device, showing a completed bias woven fabric formed thereon; and

Fig. 5 is a diagrammatic illustration of a further modified form of strand supporting device, showing completion of one step in the operation of forming my novel bias woven fabric.

My novel strand supporting device comprises a support **60**, having thereon a series of pins arranged along the perimeter of a rectangle. The support **60** may be a solid plate, but, preferably, it is cut out in the center or formed of separate pieces to allow more convenient operation, as will be hereinafter described.

In the embodiment shown in Fig. 1, there are provided four corner pins, *a*, *b*, *c*, *d*, corresponding to the corners of the support, A, B, C, D. Intermediate pins *a* and *b* is a row of substantially equally spaced pins, which row, in this case, happens to comprise 20 pins, an even number. On the opposite side of the support, between corner pins *c* and *d*, is a row *g* of pins in number equal to the number of pins in row *e*, and substantially equally spaced as in row *e*. The other two rows of pins, *f* and *h*, between corner pins *b* and *c*, and *d* and *a*, respectively, are also substantially equally spaced, with intervening distances being substantially equal to those between adjacent pins in rows *e* and *g*, but each of the rows *f* and *h* contains 21 pins, or one more pin than either row *e* or row *g*. This is a fundamental requirement of my novel strand holding device, that each row in one set of opposite parallel rows of pins shall have one more pin than either of the rows of the other set of opposite parallel rows, whether corner pins be counted or not, provided that if one or both corner pins are counted in one set, one or both corner pins shall likewise be counted in the other set. Within this requirement, the total number of pins on the support may vary in accordance with the size of fabric desired.

In Fig. 4, I illustrate a device wherein rows *e* and *g* happen each to consist of 19 pins, an odd number, and rows *f* and *h* each to consist of 20 pins.

As is obvious, by correct mathematical placement, the pins may be made to form a perfect square. Such formation is diagrammatically illustrated in Fig. 5, wherein, in addition, the corner pins (which, as hereafter explained, are not necessary) nave been omitted. In Fig. 5, the pins of rows *e* and *g* are somewhat more closely spaced than those of hows *f* and *h*, so that the total formation is along the perimeter of a square.

Fig. 5 is also a diagrammatic illustration of a device having a slightly different arrangement of pins, rows *e* and *g* having an odd number (5), and rows *f* and *h* having an even number (4), as in Fig. 4, but the odd rows, *e* and *g*, having one more pin than the even rows.

The fabric is formed in the following manner:

The operation consists primarily in two steps, (1) a winding operation, and (2) an alternate winding and weaving operation. Each of these steps is very simple when understood.

Winding operation

This operation comprises the formation of a framework of two layers of crossing courses by winding yarn or similar strand material around selected pins of the strand holding device, as will be hereafter explained. The corner pins, *a*, *b*, *c*, *d*, can be utilized for tying ends of the strand, but these pins have no other function, and therefore may be omitted, as shown in Fig. 5, since other suitable means can be provided on the support **60** for conveniently fastening the ends.

The principle of the winding operation is as follows:

Starting from a corner of the support, fasten-

ing an end of a strand x in some manner, as to a corner pin, the strand is coursed to and around the diagonally opposed end pin of the opposite row having the greater number of pins; then to and around the end pin of the opposite row having the less number of pins; then back to and around the starting corner next-to-end pin of the other greater row; then to and around the next-to-end pin of the other less row; then diagonally across, to and around another pin in the first named greater row, skipping one pin away from the one already wound; and continuing from one row to an adjacent row, always skipping one pin in each row until the yarn is brought out at another corner from the starting corner, which corner will always be at the other end of the row having the odd number of pins from the starting corner. Thus, as diagrammatically shown in Fig. 5, if the strand x is started at corner D, the strand is coursed to and around successively pins *e*5, *f*1, *g*4, *h*2, *e*3, *f*3, *g*2, *h*4, *e*1, and out corner C; or in Fig. 5, if the start is made at corner C, the same courses are made, but the layers will be reversed, crossing each other on opposite sides, as is obvious.

In Fig. 1, a study will reveal that the operation starts from corner A, and the strand x is coursed successively to and around pins *f*21, *g*1, *h*20, *e*2, *f*19, *g*3, *h*18, *e*4, and so on until the strand reaches pin *e*20, and then *f*1, after which it is coursed diagonally across to corner D, which corner is at the other end of the row having the odd number of pins from the starting corner A (row h).

In Fig. 4, the winding strand x (unshaded) is shown as starting at corner A, and is coursed to and around successively pins *f*20, *g*1, *h*19, *e*2, and so on until it reaches pin *g*19, and then *h*1, after which the strand is coursed diagonally across to corner B, which, in this embodiment, is the corner at the other end of the row having the odd number of pins from the starting corner A (row e).

In the same manner, in Fig. 1, the winding operation might be started at corner B, coursing strand x first to and around *h*1 (the diagonally opposed end pin of the opposite row having the greater number of pins); then to and around *g*20 (end pin of the opposite row having the less number of pins). In this case the strand will come out at corner C (the corner at the other end of the row having the odd number of pins from the starting corner B [row *f*]).

Or, if the strand x is started in Fig. 1 at corner C, it is coursed first to and around *h*21 (the diagonally opposed end pin of the opposite row having the greater number of pins); then to *e*1 (end pin of the opposite row having the less number of pins). In this case the strand will end at corner B (the corner at the other end of the row having the odd number of pins from the starting corner C [row *f*]).

Or, if the strand x is started in Fig. 1 at corner D, it is coursed first to and around *f*1 (again the diagonally opposed end pin of the opposite row having the greater number of pins), and so on, and will end at corner A (again the corner at the other end of the row having the odd number of pins from the starting corner D [row h]). In other words, it will be like Fig. 1, with the layers of the strand x reversed.

Likewise, in the device shown in Fig. 4, strand x may be started at any corner, provided it is coursed first to and around the diagonally opposed end pin of the opposite row having the greater number of pins.

The framework thus formed may be described as a framework of two layers of crossing courses, with the courses of one layer being disposed over the courses of the other layer, and with course changes forming an equal number of loopings on three sides of the framework, and loopings one different in number on the fourth side of the framework, no one of the courses of one layer being equal in length to any other course in the same layer.

As an aid to the winding operation, it is convenient to form the pins so that every other pin in one row is visibly distinguished from intervening pins, and so that the end pin of each row has the same distinguishing feature as the adjacent end pin of an adjacent row. Thus, as shown in Fig. 3, row e is formed with every other pin shorter than the intervening pins. Pin *h*21 (not shown in Fig. 3) may be made of the same height as the end pin *e*1.

As can be observed by reference to the pins in Fig. 4, each pin supporting the shaded strand y may readily be visibly distinguished from the pins supporting the unshaded strand x. In such case, opposite pins in the even rows f and h may have the same distinguishing feature, while opposite pins in the odd rows e and g may have a different distinguishing feature. As noted in Fig. 4, pins *h*20 and *e*1, *e*19 and *f*1, may have one distinguishing feature, while pins *f*20 and *g*1 and *g*19 and *h*1, may have a different distinguishing feature, but each pair of adjacent end pins are alike.

The same helpful function would be performed if the pins, while equal in height, were of different colors. Other indicating means might well be employed either on the pins or on the support 60. With such indicating means, the winding strand x may be coursed to and around every pin having the same distinguishing feature as the diagonally opposed end pin of the row opposite the starting corner having the greater number of pins.

Other indicating means may be used as winding guides, such as marking the starting corner and/or the first pin to be wound with special designations, to aid instruction of the user and operation of the device.

Having formed the two layers of crossing courses by the winding operation, the second step is performed, that of forming another framework interlocking with the first framework by alternately winding and weaving another strand y, while coursing it to and around all the pins unoccupied by the previously laid winding strand x.

Winding and weaving operation

The principle of the preferred method of performing this operation is to start at the corner opposite the starting corner of the winding operation with a new strand y, the end of which again may be conveniently attached to a corner pin or equivalent means. The strand y is coursed from the starting corner, always to and around the diagonally opposed, unoccupied end pin of the opposite row having the greater number of pins; then is woven under the previously laid winding strand x, to and around the end pin of the opposite row having the less number of pins; then back to and around the starting corner next-to-end pin of the other greater row; and then is woven under previously laid courses of winding strand x, and over the previously laid course of itself, to and around the next-to-end pin of the other lesser row; then diagonally across

to another unoccupied pin in the first named greater row, skipping one pin away from the pin already wound by the winding and weaving strand y, and continuing alternately weaving and winding from an unoccupied pin in one row to an unoccupied pin in and adjacent row, always skipping one pin in each row until the strand is brought out at the unoccupied fourth corner of the strand holding device.

Thus, as illustrated in Fig. 1, the winding and weaving strand y is started from corner C, and is shown coursed to and around pin $h21$, then under strand x, to and around $e1$; then over the layers of strand x to and around $f20$; then woven under previously laid courses of strand x, and over the previous course of itself, to and around $g2$, and so on, with the result being as shown in Fig. 1, when the strand y has reached pin $e11$. If the alternate winding and weaving is continued, the strand will come out at corner B, the unoccupied fourth corner.

In the embodiment shown in Fig. 4, the alternate winding and weaving of strand y (shaded) starts at corner C, and ends at corner D.

As will be obvious, the winding and weaving operation may be started from the corner opposite the ending corner of strand x, but the operation will be more difficult because the winding courses must be laid under the previously laid layers of strand x. If such method is employed, then the strand y will be woven over previously laid courses of strand x, and under previously laid courses of itself, as will be obvious from an examination of Fig. 4, if the shaded strand is started at corner D.

For use in the weaving operations, a suitable needle is convenient, the needle being preferably of a greater length than the diagonal of the strand supporting device, and of a size relative to the pin spacing to allow the needle to pass between pins of one row and pins of an adjacent row at the same time, at the angle required by the operations above described. The space formed in the center of the support is helpful in allowing manipulation of the needle to perform the weaving.

In the above specification, the word "courses" has been used as a generic term to indicate what would be warp and weft threads in a fabric not bias woven. The terms "warp" and "weft" have not been used to avoid confusion. Therefore, in the appended claims, the word "course" refers to that portion of a strand of my woven fabric which, before removal of the fabric from the support, lies between a pin of one row and a pin of another row, or between a pin of one row and a corner of the support (the four courses of maximum length); or, in other words, to a strand which, after removal of the fabric from the support, would constitute either a warp or a weft thread in a normally woven fabric. Accordingly, the term "coursing" in the appended claims refers to the act of laying a "course", as above defined.

It will be obvious that instead of employing a single strand x any number of strands might be employed, but another pin for each new strand used must be added for each pin now present, so that in winding a plurality of strands, there will be a plurality of pins positioned to receive the plurality of strands at each change of course. In such arrangement the pins may be suitably spaced in groups, without equal spacing of all the pins.

After winding a plurality of x strands, either one or more strands y may be used. Additional pins will likewise have to be added for each new y strand used, and the indicating means can be arranged to distinguish pins intended to hold strands x and those intended to hold strands y.

The fabric produced by this preferred method of operation is fully described in my above referred to co-pending application.

I claim:

1. A method of weaving a rectangular bias woven fabric comprising forming a framework of crossing strand courses by laying a strand from a corner of a series of pins arranged on a supporting device along the perimeter of a rectangle with one set of parallel rows of said series having an equal number of substantially uniformly spaced pins and with the other set of parallel rows each having substantially uniformly spaced pins only one less in number, diagonally across said support to and around the diagonally opposite end pin of the row remote from the starting corner having the greater number of pins, then to and around the adjacent end pin of the row remote from the starting corner having the less number of pins, then back to and around the starting corner next-to-end pin of the other greater row, then to and around the starting corner next-to-end pin of the other less row, then to and around a pin in the first named greater row, skipping one pin away from the one already wound, and continuing winding said strand from a pin in one row to and around a pin in an adjacent row, while forming a loop of approximately 90 degrees around every pin wound and always skipping one pin in each row, until the strand reaches another end pin in one of the greater rows, then winding said strand thereabout and to the corner of said rectangle at the other end from the starting corner of the row having the odd number of pins, and then interweaving a second strand with said framework by laying said second strand from one of the other two corners of said rectangle and on one side of said framework to and around the diagonally opposite unoccupied end pin of the row remote from the second starting corner having the greater number of pins, weaving said second strand on the other side of the first laid intervening course of said first strand to and around the adjacent end pin of the row remote from the second starting corner having the less number of pins, then back to and around the second starting corner unoccupied next-to-end pin of the row having the greater number of pins, then weaving said second strand on the said other side of the two intervening previously laid courses of said first strand, and on the said one side of the previously laid intervening course of itself to and around the adjacent second starting corner next to end pin of the less row, then to and around another unoccupied pin in the greater row remote from the second starting corner, skipping one pin away from the pin already wound by the second strand, and continuing alternately thus weaving and winding said second strand from an unoccupied pin in one row to and around an unoccupied pin in an adjacent row while forming a loop of approximately 90 degrees around every pin wound and always skipping one pin in each row until said second strand reaches the last unoccupied end pin of one of the greater rows, then winding said second strand there around and weaving said second strand to the corner of said rectangle at the other end from the second named

starting corner of the row having the odd number of pins.

2. A method of weaving a rectangular bias woven fabric comprising forming a framework of crossing strand courses by laying a strand from a corner of a series of pins arranged on a supporting device along the perimeter of a rectangle with one set of parallel rows of said series having an equal number of substantially uniformly spaced pins and with the other set of parallel rows each having uniformly spaced pins only one less in number, diagonally across said support to and around the diagonally opposed end pin of the row remote from the starting corner having the greater number of pins, then to and around the adjacent end pin of the row remote from the starting corner having the less number of pins, then back to and around the starting corner next-to-end pin of the other greater row, then to and around the starting corner next-to-end pin of the other less row, then to and around a pin in the first named greater row skipping one pin away from the one already wound and continuing winding said strand from a pin in one row to and around a pin in an adjacent row, while forming a loop of approximately 90 degrees around every pin wound and always skipping one pin in each row until the strand has been wound around and from the other end pin in the first named greater row to the corner of said rectangle at the other end from the starting corner of the row having the odd number of pins, and then interweaving a second strand from the corner of said rectangle opposite said starting corner over said first strand to and around the first named corner unoccupied end pin of the row having the greater number of pins, weaving said second strand under the first laid intervening course of said first strand to and around the adjacent first named corner end pin of the row having the less number of pins, then back to and around the second starting corner unoccupied next-to-end pin of the row having the greater number of pins, then weaving said second strand under the two intervening previously laid courses of said first strand, and over the intervening previously laid course of itself, to and around the adjacent second starting corner next-to-end pin of the less row, then to and around another unoccupied pin in the second named greater row, skipping one pin away from the pin already wound by the second strand, and continuing alternately weaving and winding said second strand from an unoccupied pin in one row to and around an unoccupied pin in an adjacent row while forming a loop of approximately 90 degrees around every pin wound and always skipping one pin in each row until said second strand is woven from the other end pin in the second named greater row to the corner of said rectangle at the other end from the first named corner of the row having the even number of pins.

3. A method of weaving a rectangular bias woven fabric comprising forming a framework of crossing strand courses by laying a strand from a corner of a series of pins arranged on a supporting device along the perimeter of a rectangle with one set of parallel rows of said series having an equal number of substantially uniformly spaced pins and with the other set of parallel rows each having uniformly spaced pins only one less in number, diagonally across said support to and around the diagonally opposed end pin of the row remote from the starting corner having the greater number of pins, then to and around the adjacent end pin of the row remote from the starting point having the less number of pins, then back to and around the starting corner next-to-end pin of the other greater row, then to and around the starting corner next-to-end pin of the other less row, then to and around a pin in the first named greater row, skipping one pin away from the one already wound, and continuing winding said strand from a pin in one row to and around a pin in an adjacent row, while forming a loop of approximately 90 degrees around every pin wound and always skipping one pin in each row, until the strand has been wound around and from the end pin remote from the starting corner in the second named greater row to the corner of said rectangle at the other end from the starting corner of the row having the odd number of pins and then interweaving a second strand with said framework by laying said second strand from the corner of said rectangle opposite said starting corner over said first strand to and around the first named corner unoccupied end pin of the row having the greater number of pins, weaving said second strand under the first laid intervening course of said first strand to and around the adjacent first named corner end pin of the row having the less number of pins, then back to and around the second starting corner unoccupied next-to-end pin of the row having the greater number of pins, then weaving said second strand under the two intervening previously laid courses of said first strand, and over the intervening previously laid course of itself, to and around the adjacent second starting corner next-to-end pin of the less row, then to and around another unoccupied pin in the second named greater row, skipping one pin away from the pin already wound by the second strand, and continuing alternately weaving and winding said second strand from an unoccupied pin in one row to and around an unoccupied pin in an adjacent row while forming a loop of approximately 90 degrees around every pin wound and always skipping one pin in each row until said second strand is woven from the other end pin in the first named greater row to the corner of said rectangle at the other end from the first named corner of the row having the even number of pins.

4. A yarn and the like supporting device comprising a support, a series of pins arranged on said support along the perimeter of a rectangle, said series including two sets of parallel rows of pins, the rows of one set having an equal number of substantially uniformly spaced pins, the rows of the other set each having substantially uniformly spaced pins only one less in number than said equal number, and each end pin in each row being spaced from a corner of said rectangle a distance not substantially greater than the distance between adjacent pins in the same row.

5. A yarn and the like supporting device comprising a support, a series of pins arranged on said support along the perimeter of a rectangle, said series including two sets of parallel rows of pins, the rows of one set having an equal number of pins, the rows of the other set each having pins only one less in number than said equal number, all of the pins in said series being substantially uniformly spaced, and each end pin in each row being spaced from a corner of said rectangle a distance not substantially greater than the distance between adjacent pins in said series.

6. A yarn and the like supporting device comprising a support, a series of pins arranged on said support along the perimeter of a square, said series including two sets of parallel rows of pins, all of the pins in said series being substantially parallel to each other, each of the pins in opposite rows of said series being substantially equally spaced from adjacent pins in the same row, but differently spaced than the pins in the adjacent rows, and each of two opposite rows of said pins having pins one more only in number than the number of pins in either of the other two rows.

7. A yarn and the like supporting device comprising a support, a series of pins arranged on said support along the perimeter of a rectangle, said series including two sets of parallel rows of pins, the rows of one set having an equal number of substantially uniformly spaced pins, the rows of the other set each having substantially uniformly spaced pins only one less in number than said equal number, each end pin in each row being spaced from a corner of said rectangle a distance not substantially greater than the distance between adjacent pins in the same row, selected pins in said series being visibly distinguished from other pins, and each pair of adjacent end pins in adjacent rows having the same distinguishing feature.

8. A yarn and the like supporting device comprising a support, a series of pins arranged on said support along the perimeter of a rectangle, said series including two sets of parallel rows of pins, the rows of one set having an equal number of substantially uniformly spaced pins, the rows of the other set each having substantially uniformly spaced pins only one less in number than said equal number, each end pin in each row being spaced from a corner of said rectangle a distance not substantially greater than the distance between adjacent pins in the same row, and selected pins in said series being visibly distinguished from other pins, with the visibly distinguished pins in said rows having the less number of pins being directly opposite each other, and with each visibly distinguished pin in said rows having the greater number of pins being adjacent a pin directly opposite a visibly distinguished pin in the opposite row.

ANNIE JEAN GASH.