Dec. 29, 1931. W. L. HOUSEMAN 1,838,994

KNITTING PROCESS

Filed Feb. 12, 1929 2 Sheets-Sheet 1

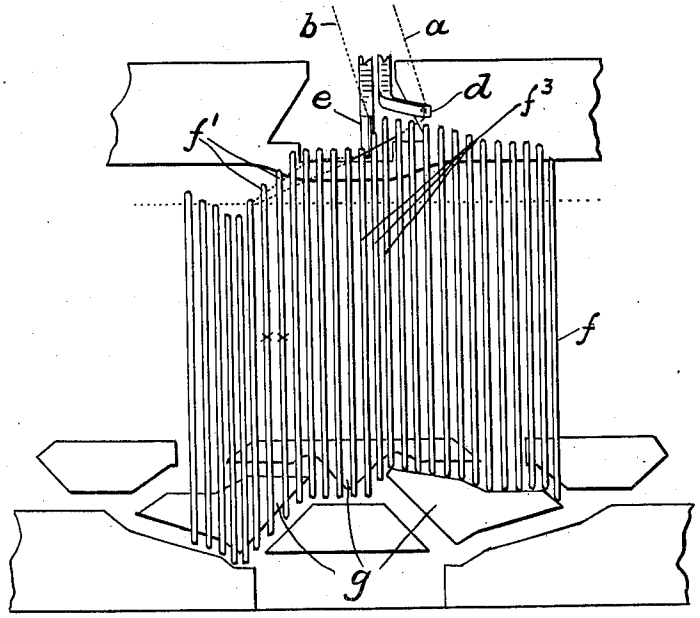


FIG. 1.

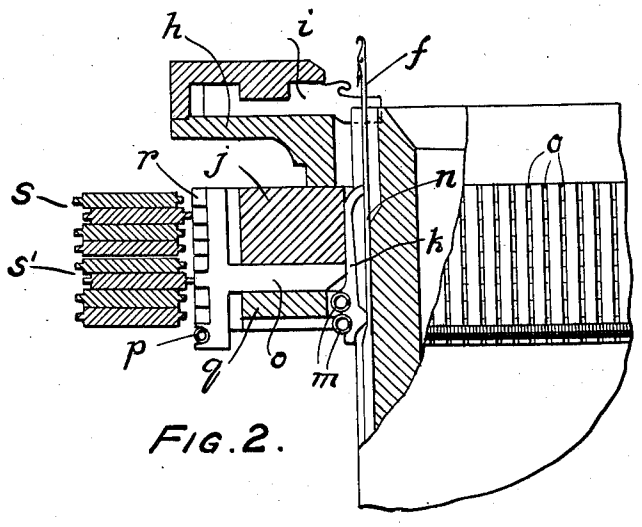


FIG. 2.

INVENTOR

WITNESS:

Robt. R. Mitchell.

Wilbur L. Houseman

BY

Busser and Harding

ATTORNEYS.

Dec. 29, 1931. W. L. HOUSEMAN 1,838,994

KNITTING PROCESS

Filed Feb. 12, 1929 2 Sheets-Sheet 2

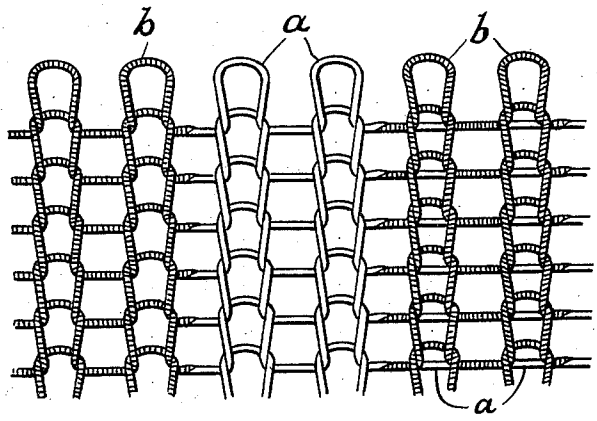


FIG. 3.

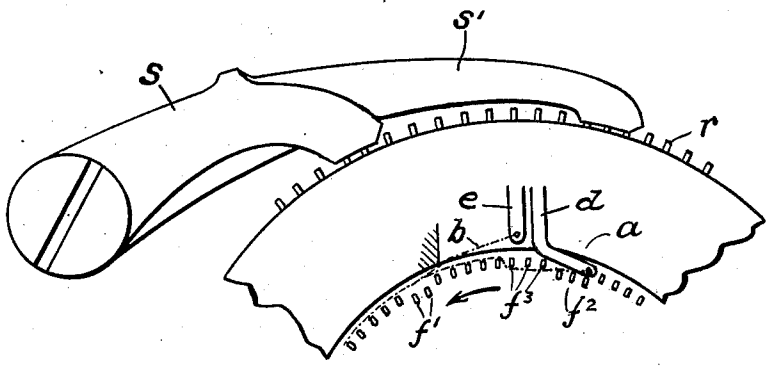


FIG. 4.

INVENTOR

Wilbur L. Houseman

BY

Brewer and Hardwig

ATTORNEYS.

WITNESS:

Robt. R. Stahel

Patented Dec. 29, 1931

1,838,994

UNITED STATES PATENT OFFICE

WILBUR L. HOUSEMAN, OF SOMERTON, PENNSYLVANIA, ASSIGNOR TO STANDARD-TRUMP BROS. MACHINE COMPANY, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE

KNITTING PROCESS

Application filed February 12, 1929. Serial No. 339,335.

It is known to knit plated fabric, that is, fabric which is formed of a backing or body yarn and a facing or plating yarn, by feeding these two yarns under different tension simultaneously to the needles; the plating yarn appearing on the face of the fabric, while the backing yarn is concealed. It is also known to produce striped and figured effects and designs by causing the two yarns knit by certain of the needles to be reversed in position so that the body yarn will appear on the face of the fabric knit by these needles, while the plating yarn is concealed. It is also known to produce striped and figured effects and designs by knitting two yarns in plated relation and at intervals causing selected needles to escape engagement with the plating yarn so that only the backing yarn is knit into the face of the fabric, the plating yarn floating at the back.

While the above described reverse plating and floating operations are both operable to produce two color work, the effects produced by reverse plating and by floating are not identical. Reverse plating produces a more durable fabric, but floating produces a more distinctly defined design and more effectively conceals the color of the thread at the back. The color effect produced by reverse plating, wherein the thread at the back may not be wholly concealed, is, however, often desired.

One object of my invention is to produce a fabric in which, in certain parts thereof, the two threads are in normal plating relation, and in which, in other parts thereof, the two threads are in reverse plating relation, while in still other parts thereof one of the threads floats back of the other. The said fabric cannot be produced, it is believed, on any known machine, nor is it believed that such a fabric can be produced by merely aggregating old mechanisms or methods for performing the two described operations.

In order that those skilled in the art may produce my improved fabric without the necessity of experimentation, I shall describe part of a circular knitting machine and mechanism applied thereto, which are adapted, during the ordinary up and down operation of the needles by the usual cams, to carry out the process I have devised for producing such fabric. In the drawings, to which reference will be made in the description—

Fig. 1 is a diagram of part of a circle of needles, the yarn feed and the usual needle actuating cams.

Fig. 2 is an elevational view, mainly in vertical section, of a part of a needle cylinder and of the means for deflecting needles which it is preferred to use in carrying out the process.

Fig. 3 is a diagram of a small section of fabric embodying my invention; the same being enlarged and the openings between threads being relatively still more enlarged in order to more clearly show the construction.

Fig. 4 is a plan view, more or less diagrammatic, of an arc of the needle cylinder, the yarn feed and the cams for selectively actuating the needle deflecting means.

Two differently colored threads, *a* and *b* are fed toward the needles. The thread *b* may be fed from a yarn carrier *e*, which may be positioned about where it is common to position yarn carriers in ordinary knitting or in the knitting of plated fabrics. The thread *a* may be fed from a yarn carrier *d*. The point of feed of thread *a* to the needles is behind (relatively to the direction of rotation of the needle cylinder) the point of feed of thread *b* to the needles. Carrier *d* is located closer than carrier *e* to the circle of needles *f*. It is preferred to impose a greater tension on thread *a* than on thread *b* so as to insure that thread *a* will be knit into the fabric outside thread *b*, thereby producing a plated knitted fabric in which thread *a* will appear on the face or outside, as shown in the middle two wales of Fig. 3. It is unnecessary, however, to impose a greater tension on thread *a* than on thread *b*, since the point of feed of thread *a* from carrier *d* is so close to the circle of needles that, in the rotation of the needle cylinder, it will be carried over and drawn frictionally against the outside of the shanks of a number of needles before it is engaged by the descending hook of a

needle and knitted into the fabric; so that it will naturally strongly tend to remain on the inside during knitting and therefore appear on the face or outside of the finished fabric. However, in feeding thread *a* to the needles as shown in Figs. 1 and 4, it will actually be fed to the inside of the normal needle circle and altogether escape engagement with the hooks of the needles in the subsequent yarn drawing movement (which occurs at a point considerably earlier than the point of feed of thread *a*) unless special means are provided to prevent such mode of operation. In order to cause thread *a* to be carried around the outside of the circle of needles, the needles are deflected radially inward, at the point f^2, Fig. 4, that is, at such point, approximately opposite the point of feed from carrier *d*, that the thread will be fed outside the deflected needles and will, after such deflected needles spring back to normal position, remain on the outside of, and be drawn against, the shanks of the needles before the thread is engaged by the needle hooks in the yarn drawing operation.

It is known to reverse plate, that is, to knit a plated fabric in which thread *b* appears on the face and thread *a* on the back. To effect this reversal, the hook ends of selected needles *f'* are deflected radially inward in proper timed relation to the yarn drawing movement and to the casting off point so as to cause the two threads to be reversed in position in the hooks of said needles, with the result that the two threads are cast off at said needles in a reverse plating relation. This is a known method of operation. The fabric thus produced is illustrated by the two wales at the left hand side of Fig. 3.

In order to knit a fabric in which one thread is knit into the fabric and the other floated, the hook ends of selected needles f^3 are not deflected radially inward at the point f^2, with the result that thread *a* is carried back of such needles and, in the subsequent yarn drawing movement of such needles, is not engaged by the hooks thereof, whereby thread *a* is not knit into the fabric but floats back of the same, as illustrated in the two right hand wales of Fig. 3.

To amplify the above description, let it be assumed, referring to Fig. 4, that all of the needles except needles f^3 are deflected radially inward at the point f^2, such deflected needles spring back into normal position as soon as they pass beyond the point f^2. Let it also be assumed that none of the needles except needles *f'* are deflected inwardly in timed relation to the yarn drawing. Making such assumptions, all the needles except needles *f'* and f^3 will knit a normal plated fabric in which yarn *a* will appear on the face; needles *f'* will knit a reverse plated fabric; and needles f^3 will knit a fabric in which only thread *b* forms stitched loops, thread *a* floating on the back of the fabric.

In order to selectively bend back needles, it is preferred to utilize the mechanism disclosed and claimed in an application filed by me July 29, 1927, Serial No. 209,393. This mechanism is shown in Fig. 2. The needles *f* are moved up and down in a normal knitting wave by cams *q* operating in the usual way. Fastened to the needle cylinder is the sinker dial *h*, which carries the sinkers or web holders *i*, which cooperate with the needles in the usual manner to form the stitches.

Below the sinker dial *h* is a slotted jack dial *j*, which is attached to the sinker dial. Pressers *k* are placed in the needle cylinder slots after the needles have been inserted and are held in place by the two spring bands *m*. These pressers are so shaped that they bear against the needles at the extreme upper ends of the pressers and also at points opposite the spring bands *m*. The needle cylinder slots are of greater than normal depth at their upper ends, forming shoulder *n*. The needles are unsupported above these shoulders, which act as fulcrums when needles are pushed back by the upper ends of pressers *k*. The jack dial *j* has slots corresponding in number with the slots in the needle cylinder. At intervals and in groups in accordance with a pattern which is to be formed in the knitted fabric, jacks *o* are inserted in the dial slots. These jacks are held lightly in contact with their corresponding needle pressers *k* by a spring band *p*.

A threaded clamp ring *q* holds the jacks in their proper vertical position. The jacks are formed with slots on their rear ends so that sections may be broken out in different places, leaving butts *r*, which may be in any one of any number of (say eight) different vertical positions.

The cams *s*, *s'* for operating the butts *r* should correspond in number to the number of vertical positions of the butts. Each cam is in alignment with one of the corresponding butt locations on jacks *o*. These cams do not revolve and may be moved, by appropriate pattern mechanism known in the art, into and out of the paths of the butts *r* of jacks *o*.

When one or more of the cams *s* or *s'* are moved and held in the path of jacks *o* having butts *r* corresponding to the vertical positions of such cams, these jacks will be pushed inward and will in turn rock the corresponding pressers or pushers *k*, thereby springing the corresponding needles *f* at the fulcrum point *n*, causing their hooked ends to be bent back out of line with adjacent undeflected needles in the normal knitting plane.

Since provision must be made for deflecting both selected needles *f'* and also all of the needles (except when thread *a* is to be floated) at point f^2, two sets of needle deflecting mechanism including two sets of cams *s*, *s'* are

provided. In Fig. 4, the top cam of one set of cams is lettered s, while the top cam of the other set of cams is lettered s'. The two sets of cams are similarly lettered in Fig. 2. It will be understood that in an accurate section through either of the two needle deflecting mechanisms, only one set of cams, s or s', would appear; but both sets of cams are shown in Fig. 2 in order to illustrate their respective vertical positions and make clear how they act independently on the butts r of jacks o.

By means of the described needle deflecting mechanism, any needle may be deflected inward or bent back at either point f^2 or at the stitch forming point, or at both points, at any course of knitting, whereby if threads a and b are of different colors, not only stripes, but designs of an indefinite variety may be produced in any desired parts of the fabric. While these effects have heretofore been produced in knitted fabric, they have been produced either by reverse plating alone or by floating alone, whereas, in my invention, the effect is produced both by reverse plating and by floating. Since the effects produced by reverse plating and floating are similar, but by no means identical, the advantage of my invention is obvious, since it enables either of the two effects to be produced at will.

One of the pronounced advantages of the invention is the fact that reverse plating and floating are both produced by the same kind of operation, namely, by deflecting needles radially inward. This kind of operation presents decided advantages over any other known kind of operation for producing either effect. It is true that needles have been deflected radially inward to produce reverse plating and it is also true that needles have been deflected radially outward to cause the needle to miss yarn; but my invention does not involve the mere, or any, association in one machine of two old mechanisms. Nor is the mode of operation the same as would occur if it were possible to associate in one machine the two old mechanisms. In my invention all the needles are deflected radially inward at one point in the needle circle, whether it is intended to effect normal plating or reverse plating, while selected needles are not so deflected, at the same point in the needle circle, when it is intended that one thread shall float. Further, in normal plating, instead of relying on differential tension upon two threads to determine the order in which such threads are knit into the fabric, provision is made for determining this order irrespective of comparative tension. It is only when reverse plating is to be effected that the old mode of operation by needle deflection is retained, but even in this case, this old mode of operation will not be effective to reverse plate unless the needles have been previously deflected at another point in the circle.

The mechanism illustrated herein is claimed in my application Serial No. 445,906, filed April 21, 1930.

Having now fully described my invention, what I claim and desire to protect by Letters Patent is:

1. The process of knitting a fabric upon a circular series of independent needles which comprises feeding two threads to the needles and so knitting them into the fabric that one thread normally appears on the face in plated relationship to and directly adjacent the other thread, so manipulating said threads at one point in the circle of needles that the second named thread appears on the face in plated relationship to and directly adjacent the first named thread, and at an earlier point in the circle of needles causing one thread to escape engagement with selected needles so that only the remaining thread will be knit into the fabric by such selected needles.

2. The process of knitting a fabric upon a circular series of independent needles which comprises feeding two threads to the needles and so knitting them into the fabric that one thread normally appears on the face in plated relationship to and directly adjacent the other thread, so manipulating said threads at one point in the circle of needles that the second named thread appears on the face in plated relationship to and directly adjacent the first named thread, and at an earlier point in the circle of needles causing the first named thread to escape engagement with selected needles so that only the second named thread will be knit into the fabric by such selected needles.

3. The process of knitting a fabric upon a circular series of independent needles which comprises feeding two threads toward the needles at different points in the needle circle, so feeding one thread that it will be engaged by the hooks of all the needles, deflecting certain of said needles, so feeding the other thread toward the needles that it will be engaged by only the hooks of needles so deflected and so manipulating the threads when both of them have been engaged by needle hooks that in some parts of the fabric one thread is on the face in plated relation to the other thread and in other parts of the fabric the threads are in plated relationship but in reverse order.

4. The process of knitting a fabric upon a circular series of independent needles which comprises operating the needles independently to knit both threads into the fabric in plating relation, and while such threads are being normally acted upon thereby in a normal plating relation, so deflecting certain of said needles at the thread receiving end as to effect a change from normal plating to reverse plating, so feeding one thread to the needles that it will be engaged by all the needles and so feeding the other thread to the

needles and so deflecting selected needles that the last named thread will be engaged only by needles so deflected.

5. The process of knitting a fabric upon a circular series of independent needles which comprises feeding two threads toward the needles at different points in the needle circle, so feeding one thread that it will be engaged by the hooks of all the needles, deflecting certain of said needles, so feeding the other thread toward the needles that it will be engaged by only the hooks of needles so deflected, knitting the two threads that have been engaged by said deflected needles in normal plated relation and during the knitting operation, while the two threads are being acted upon in plating relation, deflecting certain of said needles at the stitch forming point to effect a change from normal plating to reverse plating.

6. The process of knitting a plated fabric upon a circular series of independent needles which comprises feeding one thread so that it will be engaged by needle hooks in the yarn drawing movement to form stitched loops, feeding the other thread toward the inside of the circle of normally positioned needles at a point substantially earlier than the point of yarn drawing movement and at the same point deflecting inwardly the hook ends of selected needles, thereby causing the second named thread to be drawn arcuately across and in frictional contact with the outside of the selected needles and to be engaged by their hooks and to escape engagement with the hooks of the other needles.

7. The process of knitting a plated fabric upon a circular series of independent needles which comprises feeding one thread so that it will be engaged by needle hooks in the yarn drawing movement to form stitched loops, feeding the other thread toward the needles at a point a substantial distance back of the point of yarn drawing movement and causing the second named thread to be drawn arcuately across and in frictional contact with the outside of successive needles before reaching the point of yarn drawing movement, whereby said thread will be held at the inside of the needle hooks during the yarn drawing movement and will appear on the face of the finished fabric in plating relation to the first named thread, and during the knitting operation, while the two threads are being acted upon in a plating relation, deflecting certain needles at the stitch forming point to effect a change from normal plating to reverse plating.

8. The process of knitting a fabric upon a circular series of independent needles having hooks extending radially outward, which comprises feeding a thread to the inside of the circle of normally positioned needles at a point substantially back of the point where the yarn is drawn down to draw a loop through the loop of another course so that said thread will, in said yarn drawing movement, escape engagement with the hooks of needles that were so normally positioned at the feed point, and deflecting inwardly the hook ends of selected needles at the feed point to cause said thread to feed to the outside of such needles and in position to be engaged by the hooks of such selected needles in said yarn drawing movement.

9. The process of knitting a plated fabric upon a circular series of independent needles having hooks extending radially outward, which comprises feeding one thread so that it will be engaged by needle hooks in the yarn drawing movement, feeding the other thread to the inside of the circle of normally positioned needles at a point a substantial distance back of the point of stitch formation so that it will subsequently escape engagement with the hooks of needles which were so normally positioned at the feed point, and deflecting inwardly the hook ends of selected needles to cause the second named thread to feed to the outside of such needles and contact therewith and be in position to be engaged by the hooks of such needles in their stitch forming movement, whereby the second named thread when engaged by the hooks of selected needles, will appear on the face of the finished fabric in plating relation to the first named thread and, when escaping engagement with the hooks of other needles, will float on the back of the fabric.

10. The process of knitting a plated fabric upon a circular series of independent needles having hooks extending radially outward, which comprises feeding one thread so that it will be engaged by needle hooks in the yarn drawing movement, feeding the other thread to the inside of the circle of normally positioned needles at a point a substantial distance back of the point of stitch formation so that it will subsequently escape engagement with the hooks of needles which were so normally positioned at the feed point, and deflecting inwardly the hook ends of selected needles to cause the second named thread to feed to the outside of such needles and contact therewith and be in position to be engaged by the hooks of such needles in their stitch forming movement, whereby the second named thread when engaged by the hooks of selected needles, will appear on the face of the finished fabric in plating relation to the first named thread and, when escaping engagement with the hooks of other needles, will float on the back of the fabric and during the knitting operation, while two threads are being acted upon in a plating relation, deflecting selected needles at the stitch forming point to effect a change from normal plating to reverse plating.

11. The process of knitting, upon a circle of independent needles, a fabric formed of a

plurality of threads in parts of which a plurality of threads are in normal plating relation, in parts of which a plurality of threads are in reverse plating relation, and in parts of which a thread floats, which comprises feeding the threads toward the needles and deflecting different combinations of needles at different points in the circle of needles, the deflection of selected needles at the earlier point determining whether one of said threads shall be subsequently engaged by the hooks of predetermined needles in the downward loop drawing movement thereof, and the deflection of selected needles at the later point, while a plurality of threads are being acted upon in a plating relation, effecting a change from normal plating to reverse plating.

12. In the process of knitting fabric upon a circle of independent needles having outwardly extending hooks, so feeding a thread toward the needles as to cause it to extend inside the circle of needles which are normally positioned at the feed point and thereby subsequently escape engagement with the hooks of such needles in their subsequent down ward loop drawing movement, and deflecting the hook ends of selected needles inwardly at the feed point to cause said thread to extend outside deflected needles and thereby be subsequently engaged by the hooks of such needles in their subsequent downward loop drawing movement.

13. The process of knitting a fabric which comprises feeding only two yarns toward the needles and so manipulating certain of said needles that different stitches are formed respectively of plated loops, reverse plated loops, and loops composed of one yarn only.

14. The process of knitting a fabric which comprises feeding only two yarns toward the needles and so deflecting certain of said needles that different stitches are formed respectively of plated loops, reverse plated loops, and loops composed of one yarn only.

15. The process of knitting a plated fabric composed of two threads upon a circular series of independent needles which comprises feeding a thread to the needles at about the stitch forming point, feeding a second thread toward the needles at a substantially earlier point in the circle of needles, and so manipulating needles at both points that different stitches are formed respectively of plated loops composed of two yarns only, reverse plated loops composed of two yarns only, and loops composed of one yarn only.

16. The process of knitting a plated fabric composed of two threads upon a circular series of independent needles which comprises feeding a thread to the needles at about the stitch forming point, feeding a second thread toward the needles at a substantially earlier point in the circle of needles, and so deflecting needles at both points that different stitches are formed respectively of plated loops composed of two yarns only, reverse plated loops composed of two yarns only, and loops composed of one yarn only.

17. The process of knitting a fabric upon a circular series of independent needles which comprises feeding two threads towards the needles at different points in the needle circle, so feeding one thread that it will be engaged by the hooks of all the needles, in the formation of certain courses deflecting inwardly the hook ends of certain of said needles, and in the formation of other courses causing the hook ends of said certain needles to follow a normal path, and so feeding the other thread towards the needles that it will be engaged only by the hooks of needles so deflected.

In testimony of which invention, I have hereunto set my hand, at Philadelphia, Pennsylvania, on this 22nd day of January, 1929.

WILBUR L. HOUSEMAN.