May 19, 1931. W. L. HOUSEMAN 1,805,625

KNITTING MECHANISM

Original Filed Feb. 20, 1929 2 Sheets-Sheet 1

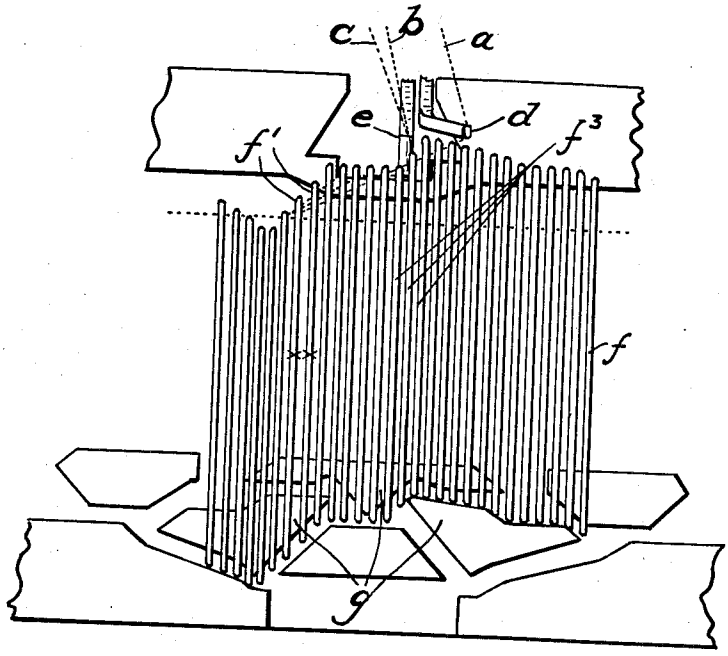


FIG. 1.

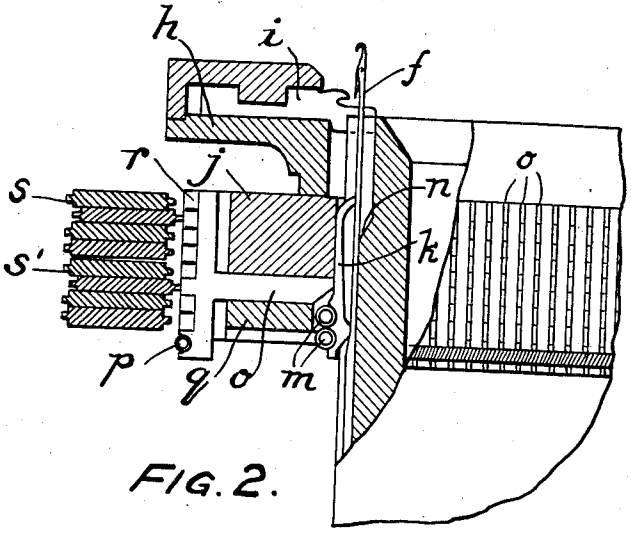


FIG. 2.

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FIG. 4.

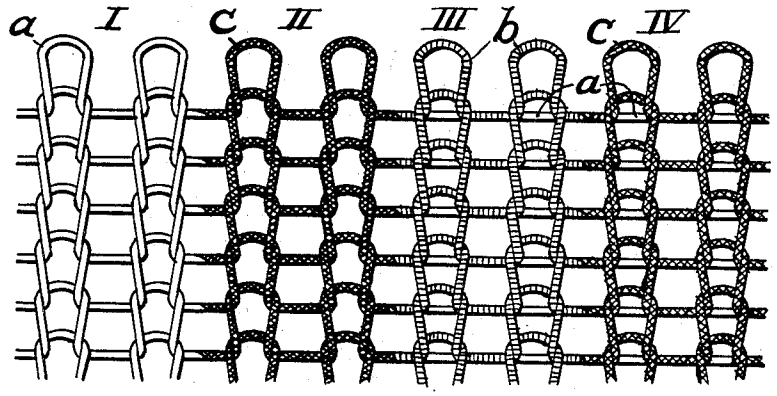


FIG. 3.

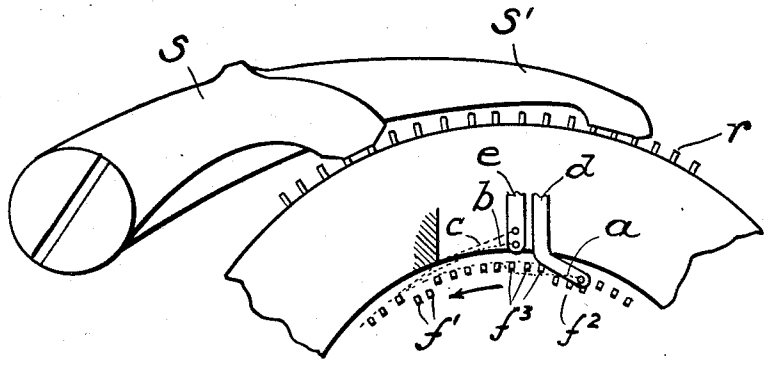


FIG. 5.

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Patented May 19, 1931 1,805,625

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 MECHANISM

Original application filed February 20, 1929. Serial No. 341,374. Divided and this application filed April 21, 1930. Serial No. 445,906.

This invention relates to a machine for knitting plated fabrics and particularly to a machine capable of producing four variations in structure in a plated fabric.

This application is a division of my prior application Serial Number 341,374, filed February 20, 1929, and is directed to the mechanism disclosed in that application and my application Serial Number 339,335, filed February 12, 1929.

It is known to knit plated fabric formed of three threads, namely, a plating thread which is normally on the face, a backing thread which is normally on the back, and a middle thread which is normally in the middle; all knit into the fabric in plating relation. It is also known to bring the backing thread onto the face of the fabric either by reversing or otherwise changing the order of the threads while maintaining them in plating relation. It is also known to bring the middle thread onto the face of the fabric by reversing or otherwise changing the order of the threads while maintaining them in plating relation; also by knitting in the middle thread and the plating thread in reverse plating relation and floating the backing thread; also by knitting in only the middle thread and floating the other threads.

Thereby three color striped and figured effects and designs of great variety can be produced.

The effect produced by knitting in the three threads in a different order so as to bring the backing thread or the middle thread to the face is not identical with the effect produced by bringing the backing thread or the middle thread to the face and floating one or both of the other threads. One object of my invention is to provide a machine whereby there may be produced a fabric in which, in certain parts thereof, one of the threads is on the face in plating relation to the other threads, while in other parts thereof the same thread is on the face while one of the other threads floats. Thereby not only can three color effects be produced, but variations of a single color effect can be produced. In the drawings and following description, one example of such a fabric is disclosed.

Heretofore, in knitting three color fabrics as above described, the threads were manipulated by deflecting selected needles in the yarn drawing operation, by prematurely depressing selected needles to cause them to escape engagement with one or two threads, or by both operations combined; and the positioning of the plating thread on the face in normal plating has been effected by imposing a greater tension on that thread than on the other two threads. The premature depression of certain needles has been effected by providing such needles with shoulders of different width, which are actuated by a specially constructed radially movable cam, whose action in drawing down a given shouldered needle either at the normal time or prematurely depends on its radial position and on the width of the needle shoulder. Such shouldered needles must be constructed with the greatest accuracy, since a slight departure from the calculated width of the shoulders renders the operation uncertain and may produce fabric in which the designs are defective. Another and important object of the invention is to provide a machine which will simplify the method of causing a thread to escape engagement with selected needles, and avoid the use of specially constructed shouldered needles and specially constructed actuating cams.

The fabric herein described and shown cannot be produced, it is believed, on any known machine except that herein disclosed, nor is it believed that such a fabric can be produced by merely aggregating old mechanisms or methods for performing the operations hereinafter particularly described.

There will now be described a preferred form of my improved machine, reference being made to the accompanying drawings, in which:

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 the 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 diagram showing the relative positions of the threads in the parts of Fig. 3 immediately below it.

Fig. 5 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.

Three differently colored threads *a*, *b* and *c* are fed toward the needles. Threads *b* and *c* 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 fabric. Greater tension is imposed on yarn *b* than on yarn *c* so that yarn *b*, when knitted into the fabric, will overlie yarn *c*. The thread *a* may be fed from a yarn carrier *d*. The point of feed of thread *a* to the needles in behind (relative to the direction of rotation of the needle cylinder) the point of feed of threads *b* and *c* to the needles. Carrier *d* is located closer than carrier *e* to the circle of needles. A greater tension may be imposed on thread *a* than on threads *b* and *c* so as to insure that thread *a* will be knit into the fabric inside threads *b* and *c*, in order that in the finished plated fabric thread *a* will appear on the face or outside, as shown in the two wales I of Fig. 3. It is unnecessary, however, to impose a substantially greater tension on thread *a* than on threads *b* and *c*, 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 5, 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 in advance of 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. 5, 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.

In order to reverse plate, that is, to knit a plated fabric in which the above described order of the threads is reversed, 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. This, per se, is a known method of operation. In the finished fabric thread *c* appears on the face, thread *b* in the middle, and thread *a* on the back, as shown in the two wales II of Fig. 3 and the part of Fig. 4 immediately above those wales.

In order to knit a fabric in which the thread *b* appears on the face, the hook ends of selected needles f^3 are not deflected inward at at the point f^2, Fig. 5, 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 wales III of Fig. 3 and the part of Fig. 4 immediately thereabove.

In order to knit a fabric in which thread *c* appears on the face and thread *a* floats, the hook ends of selected needles f^3 are not deflected inward at the point f^2, Fig. 5, with the result that thread *a* is carried back of such needles and, in the subsequent yarn drawing movement, is not engaged by the hooks thereof. The hook ends of the same selected needles are deflected radially inward at f' in proper timed relation to the yarn drawing movement and to the casting off point. This effects a reversal of the normal positions of threads *b* and *c*, so that thread *c* appears on the face in plating relation with thread *b*, while thread *a* floats at the back, as illustrated in wales IV of Fig. 3 and the part of Fig. 4 immediately thereabove.

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. 209,383. This mechanism is shown in Fig. 2. The needles *f* are moved up and down in a normal knitting wave by cams *g* 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 atached 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 mechanisms, including two sets of cams *s*, *s'* are provided. In Fig. 5, 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'*, could 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*, *b* and *c* are of different colors, not only stripes, but designs of indefinite variety, in three colors, may be produced in any desired parts of the fabric. Different modifications of a single color may be produced by, for example, knitting thread *c* in plating relation to both the other threads (wales II, Fig. 3) or in plating relation to only thread *b*, while thread *a* floats (wales IV, Fig. 3).

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 the yarn; but the 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 the 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 of all three threads; while selected needles are not so deflected, at the same point in the needle circle, when it is intended that one thread shall float. Neither normal three thread plating nor reverse three thread plating can be effected unless the needles are previously deflected, and to effect reverse three thread plating, the needles must be deflected twice at spaced apart points in the circle of needles.

The invention is not limited to means for producing a fabric comprising at most only three threads. Thus a fourth thread, as well as thread *a*, may be fed toward the needles a substantial distance back of the point at which the yarn is drawn down to form loops. The fourth thread may be fed toward the needles in the same way that thread *a* is fed toward the needles but at a different point in the needle circle; and whether or not the fourth thread shall be knit into the fabric by a given needle will depend on whether or not such needle is deflected at the thread-feeding point. This amplification of the invention requires no illustration, since it involves a mere duplication of the yarn feed and needle deflecting devices shown herein for determining the engagement with a needle of thread *a*. It is clear that if the fourth thread is, for example, subjected to greater tension than the thread *a*, it will, if knit into the fabric by a certain needle, appear on the face of the fabric in normal plating, whereas if it is not knit into the fabric thread *a*, if knit into the fabric, will appear on the face in normal plating; that in reverse plating thread *c* will appear on the face of the fabric; and that if neither thread *a* nor the fourth thread is engaged by a needle hook, thread *b* will appear on the face of the fabric in normal knitting.

It will be seen that the mechanism just described is very well adapted to the production

of elaborate designs in knitted plated fabrics. It will be obvious that numerous variations may be made without departing from the spirit of the invention as defined in the following claims.

What I claim and desire to protect by Letters Patent is:

1. Knitting mechanism comprising a needle cylinder, needles movably mounted in the cylinder, devices cooperating with the needles to form loops at a stitch forming point, means for guiding yarns to the needles, one of the guiding means and the needles being arranged so that when the needles are in normal position they will fail to engage a yarn from the last named guiding means, means for deflecting needles out of normal position to effect engagement thereof with said yarn, and means for selectively effecting either normal or reverse plating of yarns during the formation of loops.

2. Knitting mechanism comprising a needle cylinder, needles movably mounted in the cylinder, devices cooperating with the needles to form loops at a stitch forming point, means for guiding yarns to the needles, one of the guiding means and the needles being arranged so that when the needles are in normal position they will fail to engage a yarn from the last named guiding means, means for deflecting needles out of normal position to effect engagement thereof with said yarn, and means for deflecting needles out of normal position at the stitch forming point to effect reverse plating of yarns engaged thereby.

3. Knitting mechanism comprising a needle cylinder, needles movably mounted in the cylinder, devices cooperating with the needles to form loops at a stitch forming point, means for guiding yarns to the needles, means for deflecting needles prior to the stitch forming point to selectively effect an engagement or failure of engagement of the needles with one of the yarns, and means for deflecting needles at the stitch forming point to effect reverse plating of yarns engaged thereby.

4. Knitting mechanism comprising a needle cylinder, needles movably mounted in the cylinder, devices cooperating with the needles to form loops at a stitch forming point, means for guiding yarns to the needles, one of the guiding means and the needles being arranged so that when the needles are in normal position the yarn from the last named guiding means is fed inside the circle of needles and is not engaged thereby, means for deflecting needles inwardly to effect engagement thereof with said yarn, and means for selectively effecting either normal or reverse plating of yarns during the formation of loops.

5. Knitting mechanism comprising a needle cylinder, needles movably mounted in the cylinder, devices cooperating with the needles to form loops at a stitch forming point, means for guiding yarns to the needles, one of the guiding means and the needles being arranged so that when the needles are in normal position the yarn from the last named guiding means is fed inside the circle of needles and is not engaged thereby, means for deflecting needles inwardly to effect engagement thereof with said yarn, and means for deflecting needles inwardly at the stitch forming point to effect reverse plating of yarns engaged thereby.

6. Knitting mechanism comprising a needle cylinder, needles movably mounted in the cylinder, devices cooperating with the needles to form loops at a stitch forming point, means for guiding yarns to the needles, one of the guiding means and the needles being arranged so that when the needles are in normal position the yarn from the last named guiding means is fed inside the circle of needles and is not engaged thereby, means for deflecting needles inwardly to effect engagement thereof with said yarn, and means for selectively deflecting needles inwardly at the stitch forming point to effect either normal or reverse plating of yarns engaged thereby.

In testimony of which invention, I have herunto set my hand, at Wilmington, Delaware, on this 17th day of April, 1930.

WILBUR L. HOUSEMAN.