(No Model.) 4 Sheets—Sheet 1.

C. F. SMITH.

WARP KNITTING MACHINE.

No. 422,646. Patented Mar. 4, 1890.

Fig. 1.

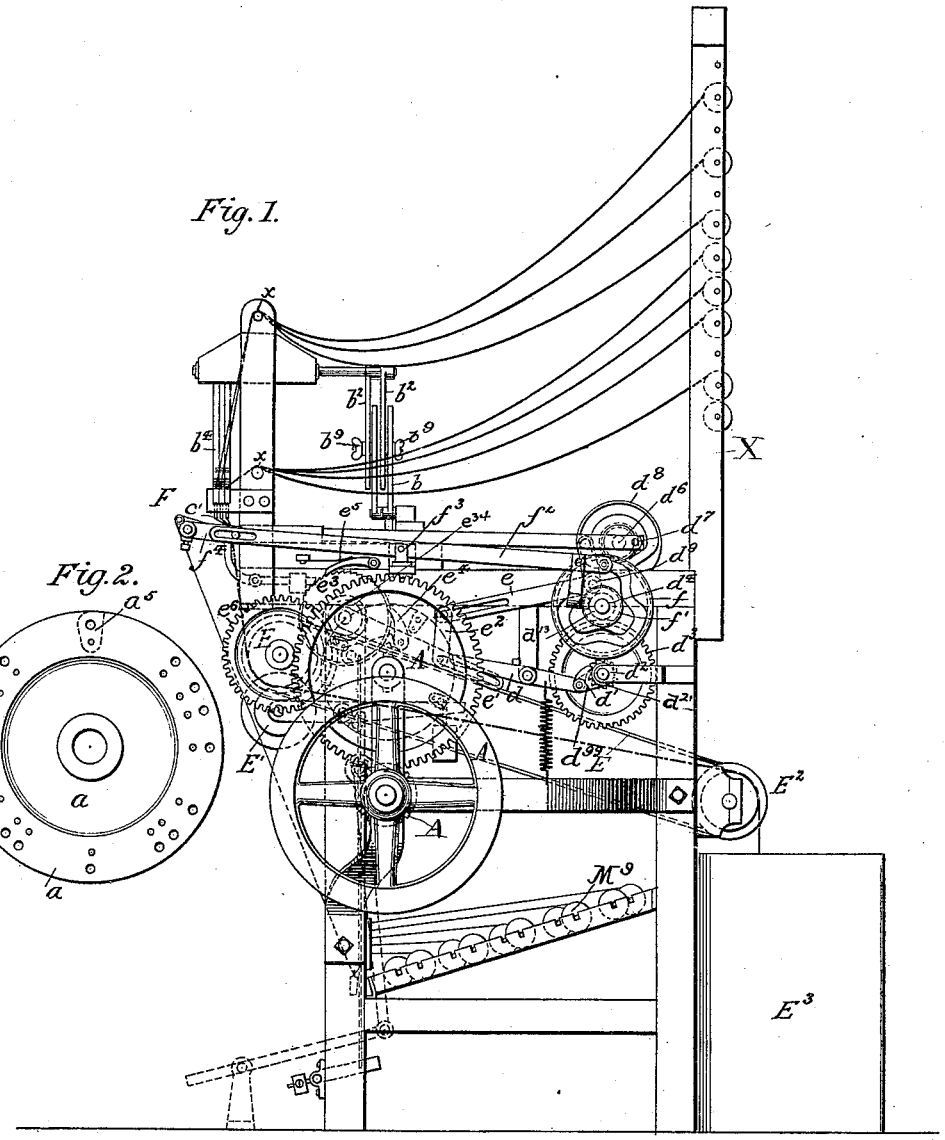

Fig. 2.

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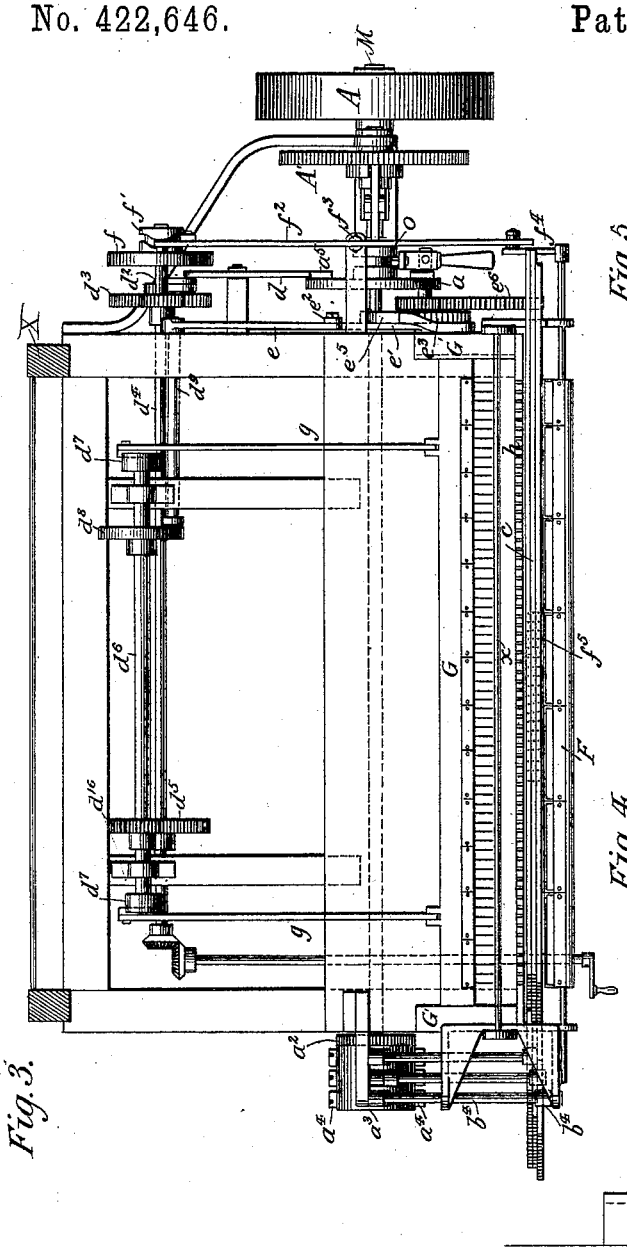

Fig. 3.

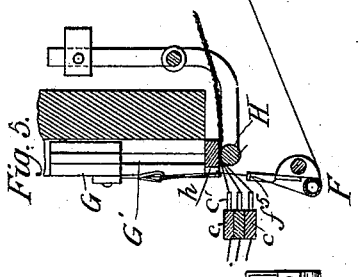

Fig. 5.

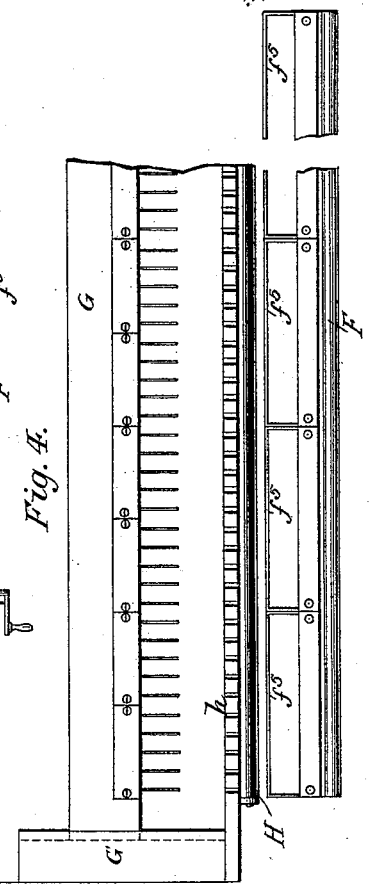

Fig. 4.

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(No Model.) 4 Sheets—Sheet 3.

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WARP KNITTING MACHINE.

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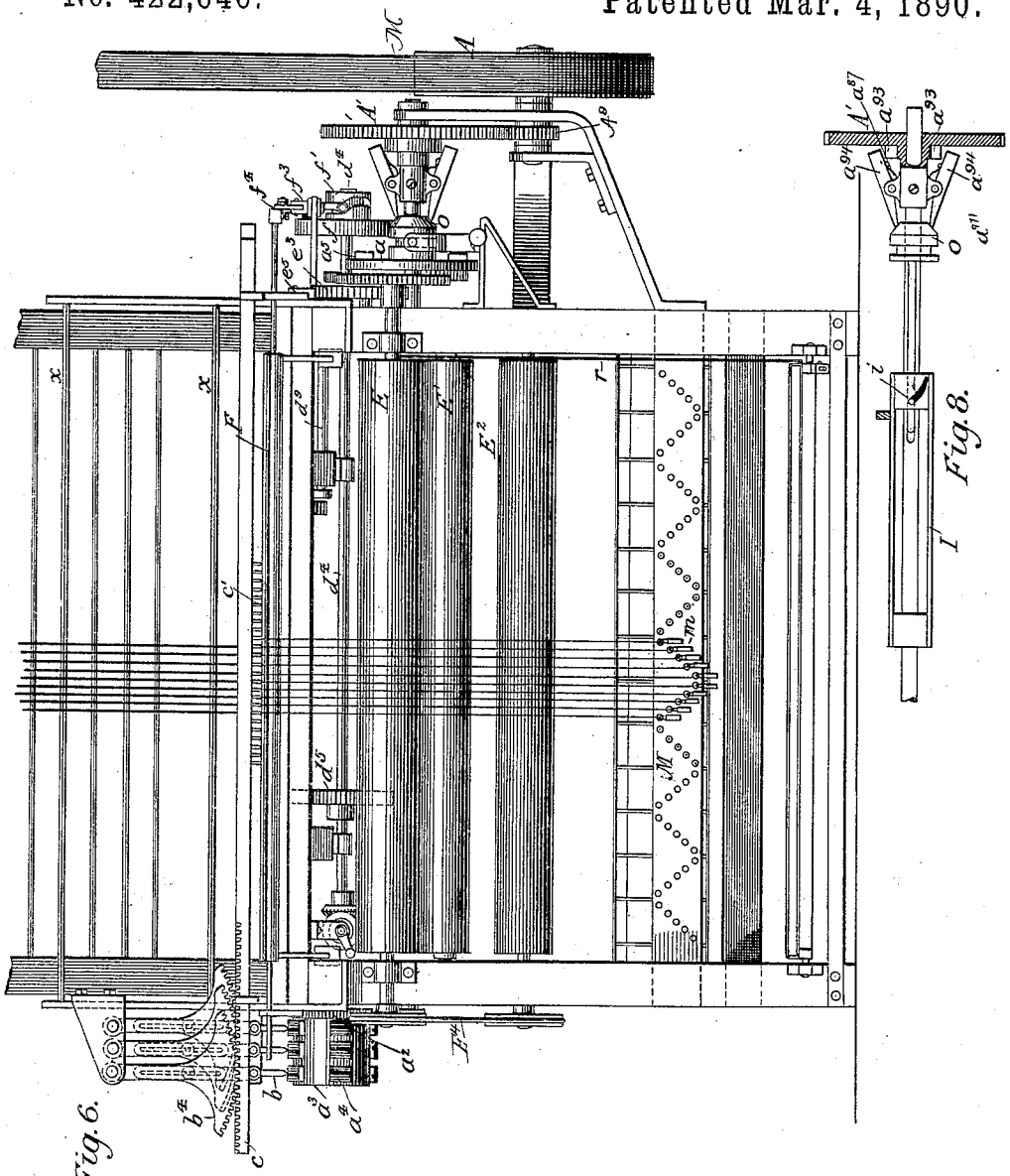

Fig. 6.

Fig. 8.

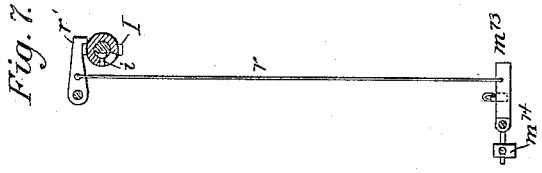

Fig. 7.

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WARP KNITTING MACHINE.

No. 422,646. Patented Mar. 4, 1890.

Fig. 13.

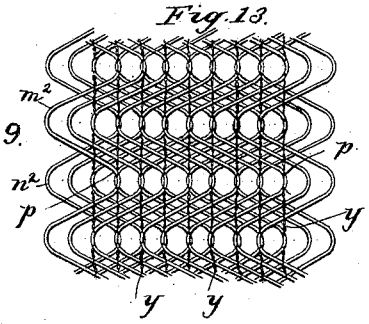


Fig. 9.

Fig. 10.

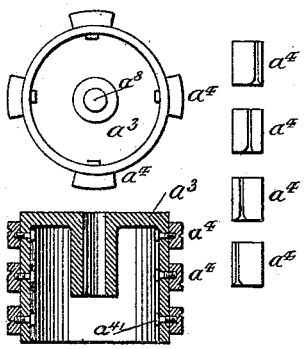


Fig. 11

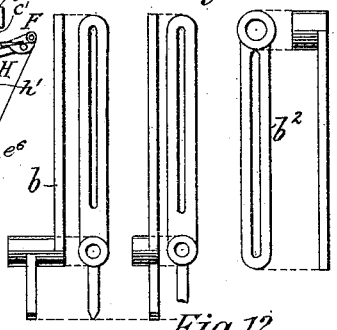
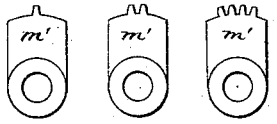


Fig. 12.



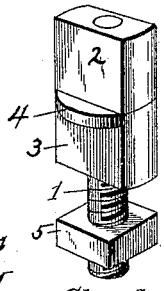
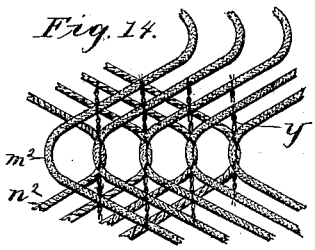


Fig. 15.

Fig. 14.



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UNITED STATES PATENT OFFICE.

CHARLES F. SMITH, OF BROOKLYN, NEW YORK, ASSIGNOR TO SCHLOSS & SONS, OF SAME PLACE.

WARP-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 422,646, dated March 4, 1890.

Application filed October 23, 1888. Serial No. 288,960. (No model.)

To all whom it may concern:

Be it known that I, CHARLES F. SMITH, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Warp-Knitting Machines, of which the following is a specification.

This invention pertains to warp-knitting machines. The machine is adapted to make different patterns of cord, braid, or other trimming. The strands of the cord, braid, or other material are formed into a pattern, and the same is secured together by a fine thread.

The principal objects of this invention are to provide a machine which will operate continuously—that is to say, whose main shaft is continuously rotating, the driving medium being either belting or treadle—in contradistinction to that class of machine in which the movements are intermittent and caused by the turning of a hand-crank. Of this latter class of machine the change in the pattern was also accomplished by hand and the whole thing controlled by a single operator. Considerable difficulty was thus experienced, in that the number of turns to change the pattern between the turns of the hand-crank to form the stitch were necessarily confusing and often resulted in turning out bad work.

This invention is designed to provide a machine which is automatic in its operation and which will be stopped automatically upon the breaking of a thread, and may be set to form any pattern or make any number of stitches between the changes in the pattern at pleasure.

The details of the machine will now be described with reference to the accompanying drawings, in which—

Figure 1 represents a right-hand end elevation of the complete machine; Fig. 2, a detail view of the disk which actuates the thread and needle-bars; Fig. 3, a plan of the machine; Fig. 4, a detail of the needle and thread-bars; Fig. 5, a cross-section of the needle and thread-bars; Fig. 6, a front elevation of the machine; Figs. 7 and 8, details of stop mechanism; Fig. 9, a left-hand end elevation of the machine; Fig. 10, details of the cam-wheel for regulating the movement of the pattern-changing bars; Fig. 11, details of the slotted arms which are operated by the pattern-cam; Fig. 12, views of different segments for operating the pattern-cam. Fig. 13 is a plan view of the material fabricated by this machine, and Fig. 14 is the same thing more in detail. Fig. 15 is a detail in perspective of the pivotal connections between arms b^2 b^3.

The main driving-pulley is represented by A. This may be driven either by belt or treadle. Through a pinion A^9 on the same shaft with this pulley the gear A′ is driven. This gear is normally loose upon the shaft, but is adapted to be locked thereto by a clutch mechanism which will be described hereinafter. The shaft upon which this gear is located is the main driving-shaft of the machine and is lettered M. Upon this shaft there is mounted a disk a. The shaft extends through the machine to the opposite end where it is adapted to receive segmental gears m' of different character, as shown in Fig. 12. Upon each revolution of the shaft the teeth of this segment m' mesh with those of a gear a^2, fixed upon a short counter-shaft a^8, mounted in the frame of the machine, turning said gear in proportion to the number of teeth on the segment. Upon this short shaft there is also mounted a cam-wheel a^3, provided on its periphery with one or more rows of movable and interchangeable blocks a^4, each having a cam-groove in its surface. These blocks are attached to the cam-wheel by means of bolts a^{41}, and they may be removed or replaced at pleasure. The number of blocks to the circle may also be varied to suit the conditions which will hereinafter appear.

The normal position of the levers b is in the grooves or slots of the blocks, and it is the intention to arrange the cam-blocks and the gearing so that each movement of the cam-wheel will be such as to leave the ends of the levers b in the slot of the next succeeding blocks, thus locking the pattern-bars until the next change. The grooves in the blocks are designed for the purpose of guiding the ends or toes of pivoted link-levers b, which project downward into the path of the said blocks. The position of the grooves in the blocks varies, some being located upon one side and some upon the other, while still oth-

ers occupy an intermediate position. At the beginning of the grooves they are slightly cut away in order to guide the toes of the levers into the grooves. The levers are pivoted, to a bracket b' and connect with slotted arms b^2, secured to rock-shafts b^3. The connections between the arms b and b^2 are made by a sliding tightening bolt and nut b^9. (Shown in Fig. 15.) It consists of a spindle 1, having a loosely-connected block 2 having parallel sides, which plays in the slot of one of the arms b and b^2. The spindle also carries a similar block 3, which is tight thereon and provided with a flange 4, which acts as a spacer between the two arms. This latter block plays in the slot of the other arm, but may be locked therein at any point by screwing up nut 5, which may be an ordinary burr or a thumb-nut, as shown in Fig. 9. This device forms a pivot upon which one or both of the arms may turn and the other slide. The blocks on the cam-wheel cause the arms b to partake of a lateral movement which is imparted in an inverse direction to the arms b^2, and by adjusting the sliding tightening bolt and nut b^9 up or down in the slots the amplitude of movement of the arms b^2 may be regulated at pleasure. The rock-shafts b^3 extend toward the front of the machine through suitable brackets or bearings, and each has attached to it an arm provided with a segment of gearing b^4. The segments stand in three parallel planes close to each other, and the gear-teeth of each meshes with a rack formed in a corresponding bar c. The bars c are the pattern-controlling bars of the machine, and they extend across the front of the same and are reciprocated independently of each other by the segments b^4.

It will readily be seen that by adjusting the tightening nut and bolt b^9 in the arms b and b^2 and the position and number of the blocks upon the cam-wheel the extent and time of movement of each of the pattern-bars c may be regulated. Any such regulation will of course change the pattern of the material worked upon. The material of which the pattern is usually made is a heavy cord, as shown in Fig. 13. The proper number of such cords is passed from the spools A^{18} A^{18} on the rack X at the back of the machine over guide-rods x x, and down through tubes c', connected with the pattern-bars of perforations in the same. Of course the number of cords used and the number passed through each pattern-bar and the number of pattern-bars used depend entirely upon the design of the pattern to be fabricated.

I have described three pattern-bars and mechanism for operating the same; but my machine may be adapted to operate one or several of the bars according to the intricacy of the designs which the machine is intended to turn out.

Returning now to the main driving-shaft M of the machine and to the disk a upon the same, it will be seen that said disk is provided with a series of holes. These holes are for the purpose of securing at regular intervals around the face and near the edge of the disk a number of lugs a^5. Through the medium of one of these lugs the feeding operation and the movements of the needle and thread-bars are accomplished, as will now be described. There is pivoted to a portion of the frame an arm d, (see Fig. 1,) whose left-hand end stands in the path of the lugs a^5 on the disk a. The opposite end of the lever is connected with an arm d^{99} on shaft d^2, carrying pawl d', which engages the teeth of a small ratchet d^{21} on the short shaft d^2. Upon this shaft is also fixed a gear d^3, which meshes with a pinion d^{13} on shaft d^4. This latter shaft, upon reference to Figs. 3 and 6, will be seen to extend through the machine and to be provided with a gear d^5, which engages a pinion d^{16} on counter-shaft d^6. The gearing between shafts d^2 and d^6 is such that upon the movement of the ratchet d^{21} the distance of one notch (which is caused by one of the lugs a^5 striking the arm d) the shaft d^2 will make one-ninth of a revolution, the shaft d^4 one-third of a revolution, and the shaft d^6 one complete revolution. Upon the counter-shaft d^6 there are fixed two cranks d^7 d^7 and also a cam-wheel d^8. In the face of this cam-wheel there is a groove in which runs a roller connected with a crank on the short counter-shaft d^9. Upon the opposite end of shaft d^9, outside the frame, is hung a slotted arm e, which is connected with a similar slotted arm e' by a link e^2. This form of connection is made for the purpose of adjustment in order to regulate the length of movement of the arm e'. Arm e' is hung or pivoted on a short shaft, upon which is also mounted a ratchet-wheel e^3. A pawl e^4 is attached to the arm e', and with each movement of said arm moves the ratchet-wheel e^3 forward a corresponding distance. The pawl e^5 simply prevents backward movement of the ratchet. The pinion e^{34} on the shaft with e^3 engages with gear-wheel e^6, which is on the shaft with the upper feed-roller E. The lower feed-roller E' is hung on the end of pivoted and weighted arms e^7, so as to bear against the upper feed-roller with a yielding pressure. The finished work passes from the needles down between these two rollers and to the back of the machine over a guide-roller E^2 and into any suitable receptacle E^3. Guide-roller E^2 is driven by belt E^4 from the feed-roller E.

I have thus described the mechanism for turning the feed-rollers, and will now proceed to describe the mechanism which moves the thread-bar F. This bar has two motions—a partial rotative and a reciprocating or lateral motion. Upon the shaft d^4 there is mounted a double cam consisting of disk f, having a cam-groove in its face, and the hub or sleeve f', having a cam-groove in its periphery. A roller plays in each of these grooves and each roller is attached to an arm

f^2, which is pivoted and swiveled at the point f^3 and is connected at its forward end with a short crank-arm f^4 upon the end of the thread-bar F. The connection between the crank and bar f^2 is by a slot and pin, in order to allow for movement of the parts upon each other. The arrangement of the cam-grooves in the disk f and hub f' are such as to cause the lever f^2 to move down and up and at about the same time to move in and out. This will cause a simultaneous partial rotation and reciprocation of the thread-bar F. This bar is for the purpose of carrying the binding-thread over the looping-needles. The thread passes from the spools M^9 in the lower part of the frame of the apparatus through guide-eyes in a plate M, thence over the thread-bar through guide-eyes f^5, thence to the needles, and finally to the work.

The needle-bar is represented by G. It has a horizontal reciprocating movement and slides in ways G′ at each end of the machine. Motion is imparted to the bar by the cranks d^7 on the shaft d^6. The cranks are connected with the bar by two pitmen g. Inasmuch as shaft d^6 makes a complete rotation every time one of the lugs a^5 strikes lever d, the needle-bar makes a complete forward and backward movement, and this double movement will be made just as many times during the rotation of the main shaft of the machine as there are lugs upon the disk a. The number of stitches or movements of the needle-bar, therefore, is not proportional to the movements producing the successive features of the pattern, inasmuch as the pattern-bars are only moved once in each rotation of the main shaft. In this way any number of stitches within certain limits may be provided for between the changes of the pattern by increasing the number of lugs a^5.

It is not deemed necessary to give the details of the forming of the stitch, inasmuch as the stitch is a common crocheting-loop, and is formed in the usual manner. I will say generally, however, that the tubes or perforations in the pattern-bar are placed the same distance apart as the needles upon the needle-bar, and that the movements of the pattern-bars always carry the tubes or perforations to positions between the path of movement of the needles. Let us suppose the machine to be threaded in the manner shown—that is to say, the pattern-cords passing from the rack through the tubes or perforations in the pattern-bars down behind tension-rod H, which is mounted on the end of pivoted bell-crank levers h', their opposite ends being weighted in a similar manner to the lower feed-roller. The tension-bar holds the cord against the smooth plate or bar h, extending along the front of the machine, through grooves in which the needles pass in making their reciprocating movement. Now, suppose one of the lugs a^5 to strike the lever d. This will cause the feed-rollers to turn and take up the proper amount of finished goods, and simultaneously the needle-bar will commence its forward movement. By the time the needles reach the full extent of their forward movement the feed will have been completed and the thread-bar then commences to rotate, lifting the binding-thread up above the needles and carrying it over and down onto the hooks in the same. The needle-bar is then withdrawn, carrying the thread with it, which is now locked within the hook by the latch thereof. Upon the return movement of the needles the loop which is in the hook is slid back upon the needles, thus lifting the latches and sliding over them onto the shank of the needles, and upon the return of the needles the said loop will be slid forward beneath the open latch and, lifting it in its forward movement, throws the latch over to lock the new loop within the hook and at the same time itself dropping over the needle onto the thread, thus forming the finished stitch. This will be recognized as the usual manner of forming the crocheting-stitch. When the main shaft has made a complete revolution, and the machine has made as many stitches as it was set to make in said revolution, the gear-segment on the end of the main shaft meshes with the gear driving the pattern-cam. This causes a certain amount of rotation of said cam and throws the levers and segments, which in turn operate the pattern-bars. The bars change the position of the cord in accordance with the manner in which the blocks on the cam-wheel have been set.

Returning now to the clutch mechanism which controls the main shaft. The details of this clutch are shown in Fig. 8. The hub of the main gear is provided with two notches a^{93}, into which two levers a^{94} are adapted to drop. These levers are pivoted to a sleeve a^{71}, fast on the shaft, and at their outer ends rest upon a conical sleeve o, while their inner ends are forced outward by springs a^{87}, as shown. The sleeve is adapted to slide upon the shaft, and the feather which connects it thereto is extended in a groove in the shaft some distance backward through the frame of the machine. On the inner end the feather has connected with it a pin i, which projects into an inclined slot formed in one of the hubs of a cage I. When the clutch is engaged, the sleeve o is in its most forward position, thus throwing the levers into the notches and connecting the gear with the shaft. From the construction of this clutch mechanism it will be seen that the cage I rotates with the shaft, and that if a stop is interposed to prevent the rotation of the cage the pin will be caused to slide within the inclined slot and carry the feather and sleeve o back, allowing the levers to spring out of the notches, thus stopping the machine. The device which I have arranged to stop the rotation of the cage I is as follows: At the point where the threads pass through the guide-plate M there is a small weight m hooked over each strand.

Directly beneath this bar or beneath the weights is a pivoted tray m^{73}, as shown in Figs. 6 and 7. This tray is balanced by weights m^{74} so that it inclines slightly upward. It is connected by a rod r with a pivoted latch r', which is located adjacent to the cage I, and is normally held in an upward position out of engagement with said cage.

When one of the threads breaks, the weight attached thereto drops into the tray and carries it down, pulling the latch r' downward and into engagement with the rotating cage, thus preventing its movement and stopping the machine in the manner already described.

Referring to Figs. 13 and 14, the design shows two layers of cord m^2 and n^2, one secured upon the other. This indicates that two pattern-bars were used. Each layer contains ten cords, and the two layers are bound together by nine rows of crochet-stitches $y\,y$. The cords are bound together by the stitches at the points $p\,p$ where they cross, and there are two stitches between every two binding-points. This particular design requires that the pattern-bars move simultaneously in opposite directions the distance of four spaces each way.

Having described my invention, I claim—

1. The combination, with the main shaft and pattern-bars, of a gear-segment for moving each pattern-bar, a rock-shaft on which each gear-segment is mounted, a lever connected with each rock-shaft, other levers, as b, pivoted to each of the said rock-shaft levers, and a wheel or cylinder mounted upon said main shaft and carrying detachable cam-blocks, said cam-blocks acting upon said levers b to rock said shaft, for the purpose set forth.

2. The combination, with the main shaft and pattern-changing bars, of a disk or cylinder driven by the main shaft, one or more series of grooved blocks detachably connected to the said disk or cylinder, the grooves in said blocks occupying different positions therein, one or more levers adapted to move in said grooves and to have their positions changed thereby, and mechanism whereby the movement of said levers will cause a movement of said pattern-changing bars, substantially as described.

3. The combination, with the pattern-bars, of gear-segments for moving the same, rock-shafts for moving the gear-segments, the slotted levers pivoted together by the adjustable set-screws, and the cam-wheel and main shaft for moving the slotted levers, whereby the extent of movement of the segments may be regulated, substantially as described.

4. The combination, with the driving mechanism, of a wheel consisting of a disk having a cam-groove in its face and a hub having a cam-groove in its periphery, a pivoted and swiveled lever which extends into and is operated in two directions by said cam-grooves, said lever provided at one end with a slot, and the thread-bar provided with a crank, the crank-pin extending through said slot and having a cross-head which prevents its withdrawal therefrom, whereby a rotary and reciprocating motion is simultaneously imparted to said thread-bar when the lever is moved.

5. In combination with the driving-shaft and driving-wheel, a clutch therefor consisting of a pair of pivoted levers adapted to enter notches on the hub of the driving-wheel, and mechanism for throwing the levers out of engagement, consisting of a conical sleeve, and the cage I, provided with an inclined slot, said sleeve and cage being connected by a feather and pin l in the shaft, and the pin projecting into said inclined slot, the latch for engaging with the cage, a balanced tray connected with the latch, and weights suspended above the tray by the threads.

In witness whereof I have hereunto affixed my name in the presence of two subscribing witnesses.

CHAS. F. SMITH.

Witnesses:
P. H. BLAUVELT,
FRED. SCHNOERING.