(No Model.) 3 Sheets—Sheet 1.

J. B. PAXTON & E. I. O'NEILL.

FASHIONING DEVICE FOR CIRCULAR KNITTING MACHINES.

No. 521,218. Patented June 12, 1894.

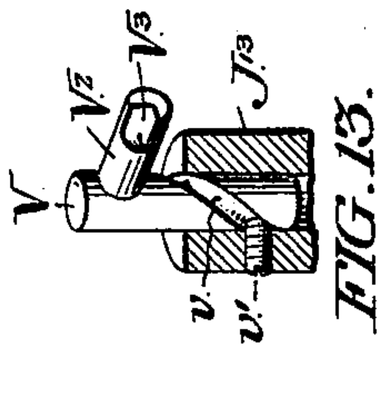

FIG. 13.

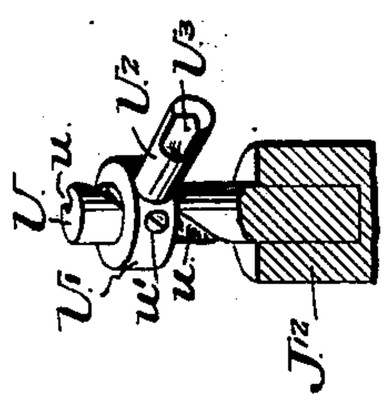

FIG. 12.

FIG. 1.

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(No Model.) 3 Sheets—Sheet 2.

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FASHIONING DEVICE FOR CIRCULAR KNITTING MACHINES.

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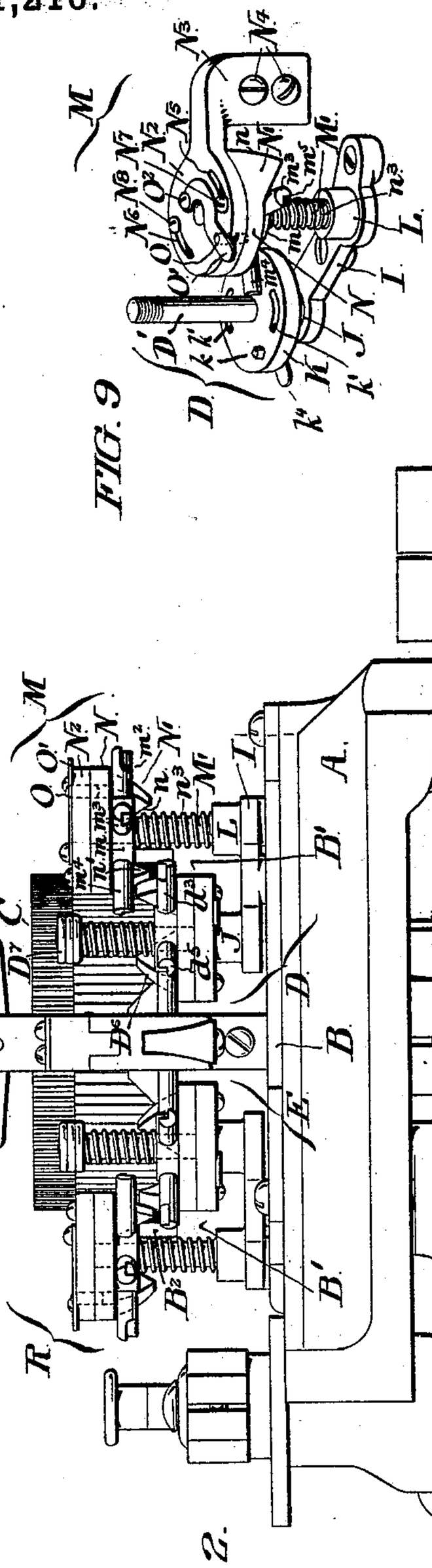

FIG. 9

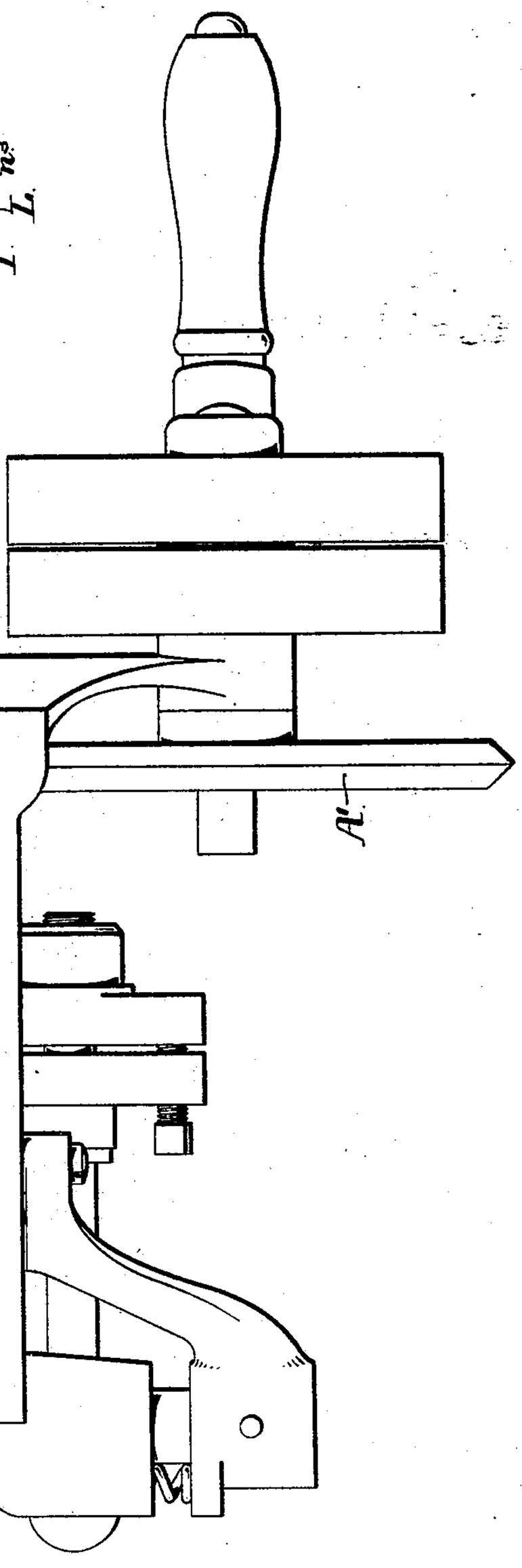

FIG. 10

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(No Model.) 3 Sheets—Sheet 3.

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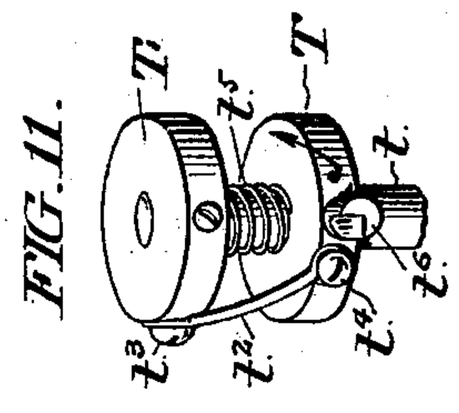

FIG. 11.

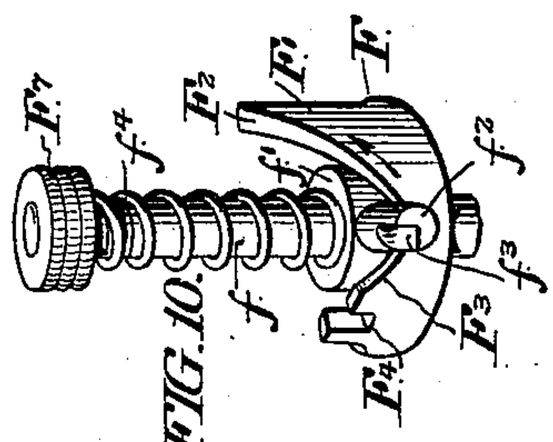

FIG. 10.

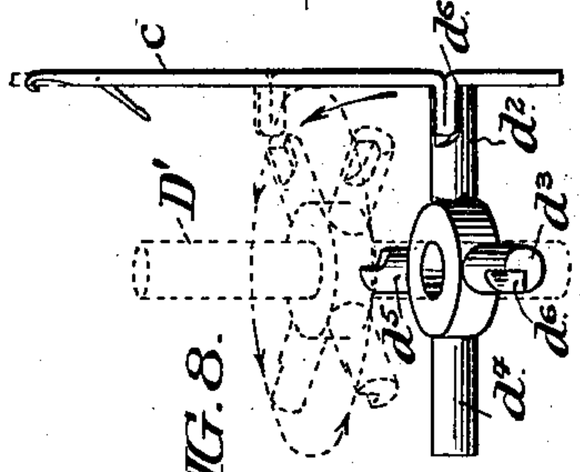

FIG. 8.

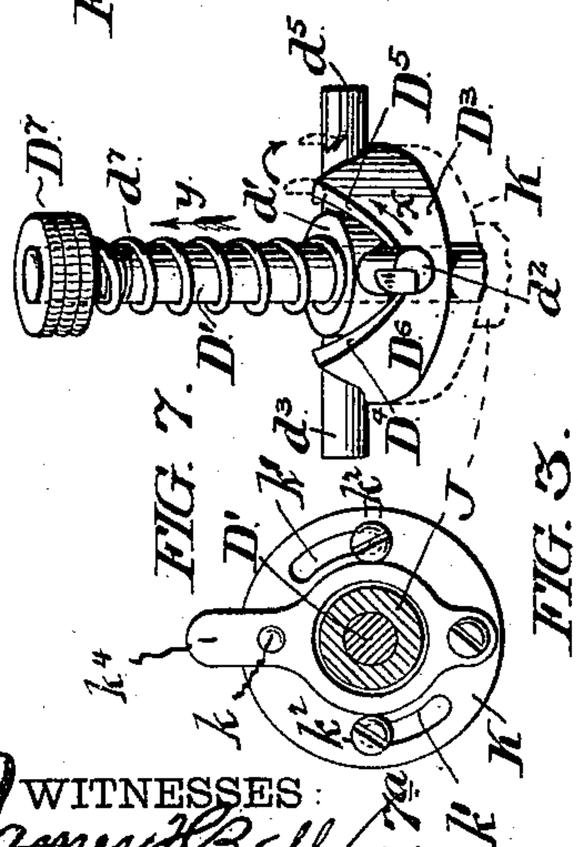

FIG. 7.

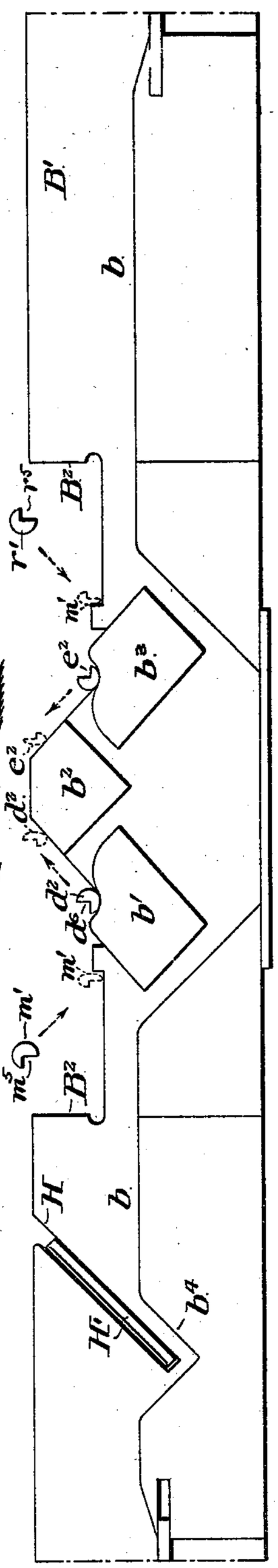

FIG. 3.

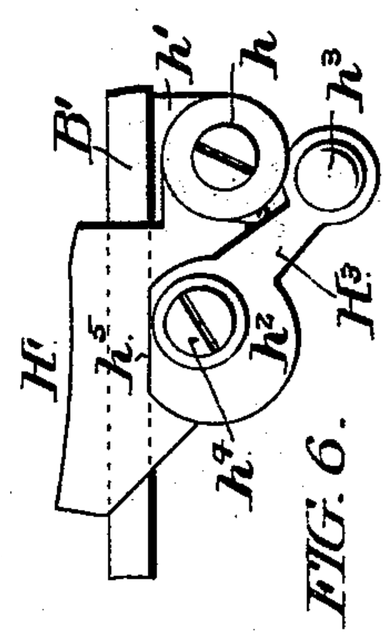

FIG. 6.

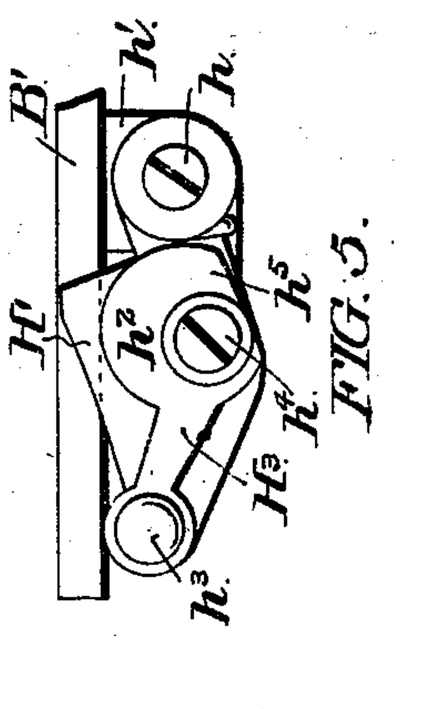

FIG. 5.

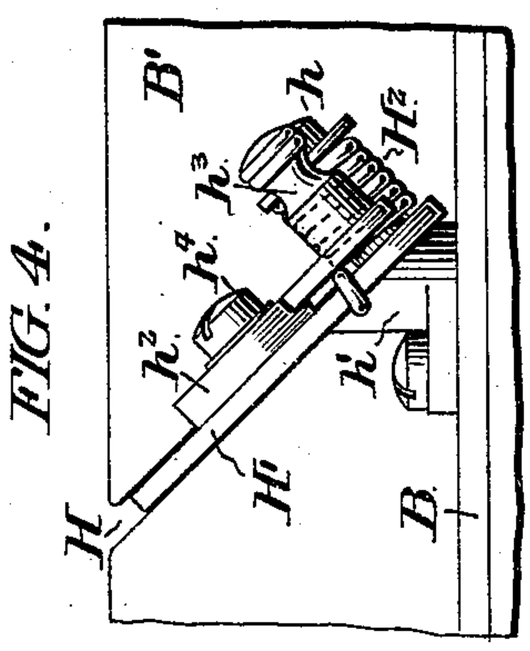

FIG. 4.

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UNITED STATES PATENT OFFICE.

JOHN B. PAXTON AND ELLIS I. O'NEILL, OF PHILADELPHIA, PENNSYLVANIA.

FASHIONING DEVICE FOR CIRCULAR-KNITTING MACHINES.

SPECIFICATION forming part of Letters Patent No. 521,218, dated June 12, 1894.

Application filed May 22, 1893. Serial No. 475,103. (No model.)

To all whom it may concern:

Be it known that we, JOHN B. PAXTON and ELLIS I. O'NEILL, both of Philadelphia, Pennsylvania, have invented certain new and useful Improvements in Fashioning Devices for Circular-Knitting Machines, whereof the following is a specification, reference being had to the accompanying drawings.

Our invention relates to the devices for raising and lowering the needles in the operations of widening and narrowing for stocking manufacture, and the following detailed description will therefore be restricted to those portions of the machine which co-operate for this purpose, the other parts, which are of course well known, being merely indicated in the drawings and referred to without particular description.

In said drawings Figure 1 represents a top or plan view of an ordinary circular knitting machine having our invention applied thereto. Fig. 2 is a side elevation thereof. Fig. 3 is a diagrammatic view, indicating the interior of the cam cylinder as developed upon a plane surface. Fig. 4 is a view, in side elevation, of the device for raising one-half of the number of needles to the idle level, at one operation, as preliminary to the narrowing and widening operations. Fig. 5 is a top view of said device when in its inoperative or retracted position. Fig. 6 is a similar view of said device in its protruded or operative position. Fig. 7 is a detail view of one of the devices for raising individual needles to the idle level, the device being shown as detached from the adjacent parts. Fig 7^a is a view of the under side of the support for said devices. Fig. 8 is a diagrammatic view of said device, illustrating its action in raising a needle. Fig. 9 (Sheet 2) is a detail view of one of the devices for lowering the individual needles from the idle level to the operative position, said device being shown as detached from the adjacent parts. For the sake of brevity these devices will hereinafter be respectively termed the lifters and depressors. Figs. 10 and 11 (Sheet 3) and Figs. 12 and 13 (Sheet 1) are detail views of modified forms of lifters, which can be substituted for the forms shown in Figs. 7 and 8, and which also by reversal, as will be hereinafter explained, can be used as depressors.

Referring to the drawings, A represents the base-plate of the machine; B the base of the cam cylinder, whose upright wall is indicated at B′, said base, B, being provided on its under surface with a bevel-rack adapted to be operated in the usual manner by the bevel-gear, A′. The needle cylinder is indicated at C. The wall, B′, of the cam cylinder is provided on its inner side with the usual needle ledges, b, and the knitting cams, b', b^2 and b^3. The whole portion of said wall, B′, immediately adjacent to and on each side of said knitting cams, is removed so as to form a large open space limited on either side by the upright edges, B^2.

An inclined slot, H, is formed completely through the wall of the cam cylinder at a point which, during the continuous rotation thereof, is in advance of the knitting cams, said slot being projected downward to a distance below the needle ledge, b, and a depression, b^4, which may be V-shaped, as shown, being formed in the needle ledge adjacent to and beneath the lower end of the slot, H. Said depression b^4 is of substantially greater depth than the vertical height of the needle hubs, so that it can completely receive one or more thereof when the needles are forced downward, as will hereinafter be described. The slot H admits the cam, H′, whereby the one-half of the group of needles are raised to the idle level at a single operation, to precede the narrowing and widening. The construction of said cam is illustrated in Figs. 4, 5 and 6. The cam consists of a flat plate or strip of metal, H′, having a thin edge, pivoted upon an inclined pin, h, which is mounted in a post, h', secured to the base, B, of the cam cylinder. A spring, H^2, encircling said post, bears against the outer edge of the cam, H′, tending normally to throw it inward or into the position indicated in Fig. 6. A lever, H^3, is pivotally mounted upon a pin, h^4, upon the top of the cam, H′, said lever being provided with a curved projection, h^2, of substantially circular outline, except on one side, where it is cut away to form a straight face, h^5. A stud, h^3, is provided at the free end of the lever for the convenience of the operator. The curved projection, h^2, upon the lever, is of such radial dimensions as that when the parts are in the position indicated in Fig. 5,

its contact with the outer surface of the wall, B′, of the cam cylinder restrains the inward movement of the cam, H′, and locks said cam in its retracted or inoperative position; but when the lever, H^3, is turned into the position indicated in Fig. 6, the cut-away or flattened portion, h^5, of the projection upon the lever, comes opposite to the surface of the wall, B′, and permits the spring, H^2, to throw the cam, H′, into its protruded or operative position. This movement of the cam pushes the hubs of one or more of the needles down into the depression, b^4, and enables the edge of the cam to engage beneath the next needle hub, so that it and the succeeding needles, as they are reached by the cam will be compelled to ride up the inclined surface thereof and thus be thrown to the idle level. The needle or needles which the entrance of the cam, H′, has thrown down into the depression, b^4, will of course immediately ride up the inclined wall thereof and resume position on the needle-ledge, *b*.

The devices for raising and lowering individual needles will now be described. These devices are arranged in pairs, that is to say, there are two lifters and two depressors, one member of each pair being located at each side of the knitting cams, so that the respective operations of raising and lowering individual needles shall recur at each half reciprocation of the cam cylinder.

The several devices are indicated in the plan view as follows: D indicates the group which constitutes the lifter at the right hand side of the knitting cams, as seen in Fig. 1, and E the corresponding lifter group at the left hand side of the knitting cams. M indicates the depressor group situated at the right hand side of the knitting cams and R the corresponding group situated at the left hand side of the knitting cams. As the members of each pair are precisely similar, except in the particular that they face or are adapted to engage the needle hubs on approach from opposite directions, it is only deemed necessary to describe one of the lifters and one of the depressors, the arrangement of the correlative ones being readily comprehensible from such description. For this purpose the group comprehended by D will now be described in detail.

Upon the base, B, of the cam ring is mounted a horizontal plate, I, upon one end of which is a short upright boss, J, supporting a disk, K. Upon this disk is adjustably secured a base, D^3, which for convenience of description will be called the cam-base, since it serves the double purpose of supporting the lifter and of guiding and raising the operative member thereof during rotation. This cam-base is composed of a disk-shaped bottom provided around one-half of its periphery with a raised wall, D^6, in which is formed a V-shaped depression, whose inclined edges, D^4 and D^5, respectively, constitute the cam surfaces whose action will be hereinafter described.

The cam-base is connected with the disk, K, so as to be rotatively adjustable about the center thereof, this being effected as follows: Arc-shaped slots, *k′*, *k′*, (see Fig. 7ª) are formed through the disk, K, and receive the necks of screws, k^2, k^2, which are secured in and extend downward from the under side of the cam-base. Said screw-necks move freely in said slots (the arcs of which are forty-five degrees) and thus permit rotation of the cam-base, while the heads of the screws secure the latter against lifting movement. The rotation of the cam-base is controlled by means of a pin, *k*, mounted in a spring arm, k^4, secured to the under side of the disk, K; said pin extending up entirely through the disk, and entering a hole in the bottom of the cam-base. So long as the pin is seated in the hole of the cam-base the latter is of course locked against rotary movement, but when the spring arm, k^4, is depressed sufficiently to free the pin from said locking hole the cam-base can be turned. Two locking holes are formed in the bottom of the cam-base at positions which respectively correspond with the extreme positions of rotative adjustment permitted by the slots, *k′*, *k′*, so that the cam-base can be locked in either of said positions, for a purpose which will hereinafter be described.

In the center of the cam-base, D^3, is rigidly mounted a vertical post, D′, which carries a hub, *d′*, freely mounted to rotate and also slide longitudinally thereon, said hub being provided with four radial arms, d^2, d^3, d^4 and d^5, respectively. A spring, d^7, is coiled about said post and bears downward against the hub, *d′*, being secured at the upper end by means of the nut, D^7, mounted at the upper end of the post, D′. It will be seen that if the hub, *d′*, be rotated by pressure applied to the end of one of the radial arms, as d^2, in the direction of the arrow, *x*, indicated in Fig. 7, said arm will be compelled to ride up the incline, D^5, of the wall, D^6, compressing the spring, d^7. As soon, however, as the arm, d^2, reaches and rides over the top of the incline D^5, (which is substantially the end of the wall, D^6, upon that side,) the pressure of the spring, d^7, will at once throw the hub downward until it reaches the flat surface at the rear of the cam-base, D^3. This rotation of the hub will, however, have brought the next radial arm, d^3, over the top of the incline, D^4, and said arm will therefore descend said incline to the bottom of the depression in the wall, D^6, and assume the position formerly occupied by the arm, d^2. It will thus be seen that by successive quarter rotations of the hub, *d′*, each arm in turn will be raised to a height corresponding to the top of the incline, D^5, and the next arm will be presented ready to repeat the action.

At the end of the radial arms an indentation or step, indicated at d^6, is formed, whose depth is sufficient to receive a needle hub, as indicated in Fig. 8. Said steps face away

from the knitting cams and by reason of the length of the radial arms and the position of that one which is for the time being at rest in the bottom of the V-shaped cavity in the cam-base the step will be presented to the hub of the end needle of the series still remaining upon the needle ledge, *b*, as the knitting cams approach said needle. The step having engaged the hub of said needle, the continued movement of the cam cylinder past the needle, will of course rotate the radial arm of the lifter and in so doing the arm will be caused to ride up the incline, carrying with it the needle whose hub is still seated in the step. When the top of the incline is reached the arm descends again, freeing the needle from the step of the arm. By this time the needle will have been raised to a level above the downward incline upon the central knitting cam, b^2, and will ride upward upon the upper incline of said cam, b^2, to the idle level. This rotation of the hub, d', and its radial arms will have brought the next of said arms in a position to ride down the incline of the cam-base; but before it reaches the bottom of the incline, the rounded under side of said next radial arm will strike upon the top of the needle hubs (in the remaining active series) and ride along thereon, passing from one to the other without engagement, until the end of the row is reached, when it will drop down from the last needle hub of the row and into its operative position ready for re-engagement.

The arrangement of the members which constitute the group, E, of the correlative lifter is precisely like that just described, except that the steps upon the lifter arms face in the opposite direction, so that said steps will be in position to engage with the end needle at the opposite end of the row when the cam cylinder moves in the reverse direction.

The needle depressing devices will now be described, and as the members of each depressor group are similar to those of the other, except that they face or are adapted to engage, in the opposite direction, a detailed description of the group M only will now be given.

Upon the same horizontal plate, I, which carries the boss, J, is mounted a second boss, L, in which is secured an upright post, M'. The top of said post is received within and supports the inverted cam-piece, N, which is provided with a cam-wall, N', having a V-shaped cavity, the two inclines being indicated at *n*, *n'*. For convenience of nomenclature, we will call this piece the "cam-top" to distinguish it from the "cam-base" of the lifters. Said cam-top, N, is adjustably secured to the disk, N^2, supported upon the overhanging bracket, N^3, which is secured to the side of the cam cylinder by means of screws, N^4. The adjustment of the cam-top, N, relatively to the disk N^2, is permitted by means of the arc-shaped slots, N^5, N^6, concentric with the disk, the cam-top, N, being held up against said disk by means of the screws, N^7, N^8, which permit the rotation of the cam-top, N, relatively to the disk through an arc of forty-five degrees. Normally the cam-top is secured against this rotation by means of a pin, O, which passes through a hole in the disk, N^2, and extends for a short distance into a corresponding hole in the top, N, said pin being connected at its upper end to a spring arm, O', secured by a screw, O^2, upon the top of the disk. By lifting the outer or free end of the spring arm, O', the end of the pin will be retracted from the hole in the piece, N, and while it is in this position said piece can be turned relatively to the disk. A second hole is also formed in the piece, N, at a point corresponding with the outer extreme position of the rotary adjustment, so that by again dropping the spring, O', the pin will enter this second hole and lock the top, N, against rotation until desired. Upon the post, M', and below the cam-top is mounted a hub, *m*, free to rotate and to slide vertically upon the post, and normally held up against the cam-top by means of the spring, n^3. Said hub has four radial arms, *m'*, m^2, m^3 and m^4, whose ends are provided with indentations or steps, m^5, formed on the under side of the arms, so that the top of the step overhangs. The purpose of these steps is to engage above the hub of a needle which has been raised to the idle level and depress it, the operation being similar to that previously described in the case of the lifters, though of course in the reverse direction. Thus when the needle approaches the arm which for the time being is at the top of the V-shaped cavity in the wall, N', of the cam-top, said needle will enter beneath and engage in the step, m^5, and as the movement of the cam cylinder continues, the arm will be rotated and forced down the incline, *n'*. Said downward movement will continue until the arm reaches the bottom of the incline, *n'*, when it will free itself from the needle hub and be forced upward by the pressure of the spring, n^3, against the hub, *m*, this action bringing into play the next radial arm by throwing it up the incline, *n*. The second arm, thus brought into position, will strike beneath the needle hubs of the idle row and will ride along from hub to hub without engagement until the end of said row is reached, when it will spring up to the extreme top of the V-shaped cavity in the cam wall, N', so as to be ready for engagement with the end needle on the next movement of the cam cylinder.

The members of the group, R, are precisely like the members of the group, M, except that the steps face in the opposite direction with reference to the knitting cams, so as to engage the needle at the other end of the idle row from that at which engagement has taken place with the first described depressor.

The behavior of the lifter and depressor arms in raising and lowering needles is dia-

grammatically illustrated in Fig. 3. The large arrow, w, indicates the general direction of motion of the cam cylinder in continuous knitting. Only the ends of the lifting arms, d^2 and e^2, and depressing arms, m' and r', are shown in this figure, the full lines representing the position of the end of the arm, which, for the time being, is operative, at the moment of its engagement with a needle hub, and the dotted lines, marked with the corresponding letter, showing the position of the end of the arm at the moment of its disengagement from the needle which has been lifted or depressed. The small arrows, which connect each full representation of the end of the arm with the dotted representation thereof, indicate the direction of this motion, and the dotted lines in each instance represent the perspective view of the end of the arm, which has turned through an arc of about twenty degrees in the course of the operation illustrated.

The devices for rotative adjustment of the cam-bases and the cam-tops of the lifters and depressors, respectively, are provided for the following purposes:

During the operation of continuous knitting, it is of course necessary that the arms of both the needle lifters and needle depressors should be out of range of the needle hubs. This position is reached by shifting the cam-base, in the one case, and the cam-top in the other, through an arc of forty-five degrees, so that the arms are thrown clear of the periphery of the needle cylinder. This position of the parts is indicated in Fig. 1. On the other hand, when the lifters are operative, the depressors must of course be out of operation and vice versa. Each cam-base and cam-top is therefore adjusted in the proper position for the action which is going on for the time being, said adjustment being permitted by the devices previously described.

By entirely cutting away the cam wall upon each side of and adjacent to the knitting cams we obtain a two-fold advantage of not only providing the required space for the necessary adjustment of the cam bases and cam tops just mentioned, but avoid frictional engagement between the wall of the cam cylinder and the needle lifting and needle depressing arms. Where, as in some cases, the wall of the cam cylinder is slotted and the faces of the slots are made to act as bearing surfaces for the actuation of the needle lifting and needle depressing devices, the wear of the bearing surfaces is liable to seriously interfere with the proper action of the parts; for it is of course essential that the bearing surfaces shall be true and, as far as possible, permanent. In our invention the bearing surfaces, which co-operate with the needle lifting and needle depressing arms, are independent of the cam wall, easily replaceable, and readily adjustable.

In Figs. 10, 11, 12 and 13, of the drawings, we have shown alternative forms or variations which can be substituted for the lifters, (and by reversal, for the needle depressors) but each operating upon the same general principle. Thus in Fig. 10 the cam-base, F, is not rotatably adjustable, but is rigidly mounted upon a post carried by the cam cylinder. Said cam-base has a cam-wall, F', whose incline F^2, upon the side which is operative for lifting the needles, is longer than in the case of the incline previously described. The post, f, is similar to the post, D', previously described, and carries a hub, f', which has but a single radial arm, f^2, provided with a step, f^3. The hub is normally pressed downward by means of a spring, f^4, coiled around the post f. The cam wall is provided with a counter incline, F^3, which is only of sufficient height to properly form a depression to seat the arm, f^2, and adjacent to the end of said incline and at a distance of about forty-five degrees from the bottom of the depression, is a notch, F^4, capable of receiving and holding the arm, f^2, when it is desired to throw the same out of an operative position. When the arm is operative, it engages with the needle hub precisely as does the arm in the other type of lifter previously described, and when rotated by the needle hub, it rides up the incline, F^2, in the same manner, carrying the needle with it; but instead of passing over the end of the incline, F^2, to drop away from the needle, the greater length of said incline permits the arm to rotate until it has passed from the range of the needle hub entirely, and the arm, instead of jumping forward over the top of the incline, slides down backward upon it, until it rests upon the hubs of the remaining needles. The only object of this device is to dispense with the use of a plurality of arms, and this is effected by causing the single arm to resume its operative position as described.

In Fig. 11, another alternative device is shown which differs from those previously specified, in that there is no cam-base, but merely a post, t, upon which an enlarged hub, T, rotates and slides vertically, a disk, T', of similar diameter, being rigidly mounted at the top of the post and connected with the hub by means of the link, t^2, which should be slightly elastic to bend laterally. Said link is freely attached to the disk by means of the screw, t^3, and to the hub by means of the screw, t^4. A spring, t^5, normally tends to throw the hub, T, downward, or away from the disk, T'. The hub, T, is provided with a short radial arm, t^6, similar to the lifting arms previously described and capable of engagement with the needle hubs in the same manner. As the arm, t^6, and hub, T, are rotated by engagement with the needle, the link connection causes the hub to rise upon the post, carrying the needle with it until the region of disengagement from the needle has been reached, when the spring, t^5, forces the hub down again, the link, t^2, thereupon effecting its return to the initial position.

In the type shown in Fig. 12 a spiral guide groove, *u*, is formed in the stationary post, U, and the hub, U′, carries an inwardly projecting stud, *u′*, which fits in said groove. The hub has a single radial arm, U^2, with a step, U^3, to engage the needle hub. As the arm, U^2, is turned in its passage by the needle, the engagement of the pin, *u′*, in the guide groove, *u*, causes the hub, U′, to rise in the same manner as before. Again in the type shown in Fig. 13, the post V is adapted to slide vertically in a socket formed in the base, J^{13}, and said post is provided with a spiral groove in which a stud, *v′*, fixed in the base, engages. Rotation of the arm, V^2, by engagement of the needle hub in the step, V^3, will of course compel the post, V, to rise. In both these last mentioned types (shown in Figs. 12 and 13 respectively) the return of the hub, U′, and of the post, V, to the initial position is effected by means of a spring which normally tends to throw them downward. To avoid confusion in the lines of said figures the representation of the spring has been omitted, but its position and mode of operation are of course obvious.

Upon a consideration of the types of our invention described in the foregoing specification it will be obvious that they all have in common a characteristic principle of operation, viz: that a rotatable arm, so mounted as to be free to move in a direction coinciding with the axis of its rotation, is combined with guiding devices which compel such movement in the direction of the axis of rotation whenever the arm is rotated. We thus obtain the needle shifting action by a movement which is the derivative of the rotation of the arm caused by its engagement with the needle hub in the act of passing by the same. While, therefore, we have specified the preferred methods of effecting this derivative movement, we do not limit ourselves to the use of the specific devices shown for effecting it, the only essential being that there should be in combination with a rotatable arm, having the capacity to move in the direction of its axis of rotation, mechanism which is capable of modifying what otherwise would be a mere movement of rotation and obtaining a resultant movement in what may be appropriately termed a spiral path. Furthermore, inasmuch as the depressors and lifters are in fact the correlatives of one another, their essential principle of operation being the same, although the particular devices desirable for accommodating them to their reverse positions are different, we shall in some of our claims hereinafter made use the term needle shifter as comprehending the device which directly engages with the needle-hub, irrespective of whether it be used to raise or lower the individual needle.

We do not claim in this application, broadly, the use of a rotatable needle shifter, nor do we claim broadly to be the first to render such needle shifter movable in the direction of its axis, devices with a limited capacity for such movement having been heretofore used. But so far as we are aware, we are the first to combine a rotatable shifter, having a capacity for movement in the direction of its axis sufficient to be operative for shifting purposes, with actuating devices, whereby the necessary resultant movement is obtained.

Having thus described our invention, we claim—

1. The combination, with the needle cylinder; the cam cylinder; and actuating mechanism for said cam cylinder; of a rotatable needle shifter, capable of movement in the direction of its axis of rotation; and actuating mechanism arranged with reference to said needle shifter, substantially as set forth, whereby movement of the needle shifter in a direction coincident with said axis is derived from the rotation caused by engagement with, and passage by, the needle hub.

2. The combination, with the needle cylinder; the cam cylinder; and actuating mechanism for said cam cylinder; of a rotatable needle shifter, capable of movement in the direction of its axis of rotation; and a cam having an incline arranged with relation to said needle shifter, substantially as set forth, whereby movement of the needle shifter in the direction of said axis is derived from the rotation caused by engagement with, and passage by, the needle-hub.

3. The combination, with the needle cylinder; the cam cylinder; and actuating mechanism for said cam cylinder; of a post carried by the cam cylinder; a needle shifter mounted to rotate and slide longitudinally on said post; a cam having an incline arranged with relation to said needle shifter, substantially as set forth, whereby sliding movement of the needle shifter upon the post is derived from its rotation thereon, and vice versa; and a spring normally tending to throw the needle shifter in a direction opposite to the cam incline.

4. The combination, with the needle cylinder; the cam cylinder; and actuating mechanism for said cam cylinder; of a post carried by the cam cylinder; a needle shifter mounted to rotate and slide longitudinally thereon; a cam having an incline arranged with relation to said needle shifter, substantially as set forth, whereby sliding movement of the needle shifter upon the post is derived from its rotation thereon, and vice versa; and means, substantially as set forth, whereby said needle shifter may be secured in different relations to the needle cylinder to throw the shifting devices into or out of operative position.

5. The combination, with the needle cylinder; the cam cylinder; and actuating mechanism for said cam cylinder; of a post carried by the cam cylinder; a hub mounted to rotate and slide longitudinally upon said post; a plurality of needle shifting arms carried by said hub; a cam wall having a V-shaped de-

pression arranged with relation to said hub and arms, substantially as set forth; and a spring normally tending to throw the hub in a direction toward the apex of said depression, whereby said arms are in succession presented for engagement with the needle hubs, substantially as set forth.

6. The combination, with the needle cylinder; of a cam cylinder having the upper portion of its wall on each side of the knitting cams entirely removed; actuating mechanism for said cam cylinder; a pair of rotatably and axially movable needle lifters arranged on opposite sides of the knitting cams and in proximity to the open portion of the cam cylinder; a pair of rotatably and axially movable needle depressors also arranged on opposite sides of the knitting cams and in proximity to the open portion of the cam cylinder, and guiding devices for said needle lifters and needle depressors, said guiding devices being independent of the cylinder wall, whereby frictional engagement between the cylinder wall and said lifters and depressors is obviated, substantially as set forth.

7. The combination, with the needle cylinder and the needles having hubs of uniform length; of a cam cylinder having a needle ledge which is provided with a depression of substantially greater depth than the vertical height of the needle hubs; an inclined movable cam adapted to force one or more needle hubs downward into said depression and engage beneath succeeding needle hubs to raise the same to the idle level; and means for protruding said cam into, or withdrawing it from, the range of the needle hubs, substantially as set forth.

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Witnesses:
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