2 Sheets--Sheet 1.

D. H. CAMPBELL.
Sewing Machine.

No. 231,954. **Patented Sept. 7, 1880.**

Fig. 1.

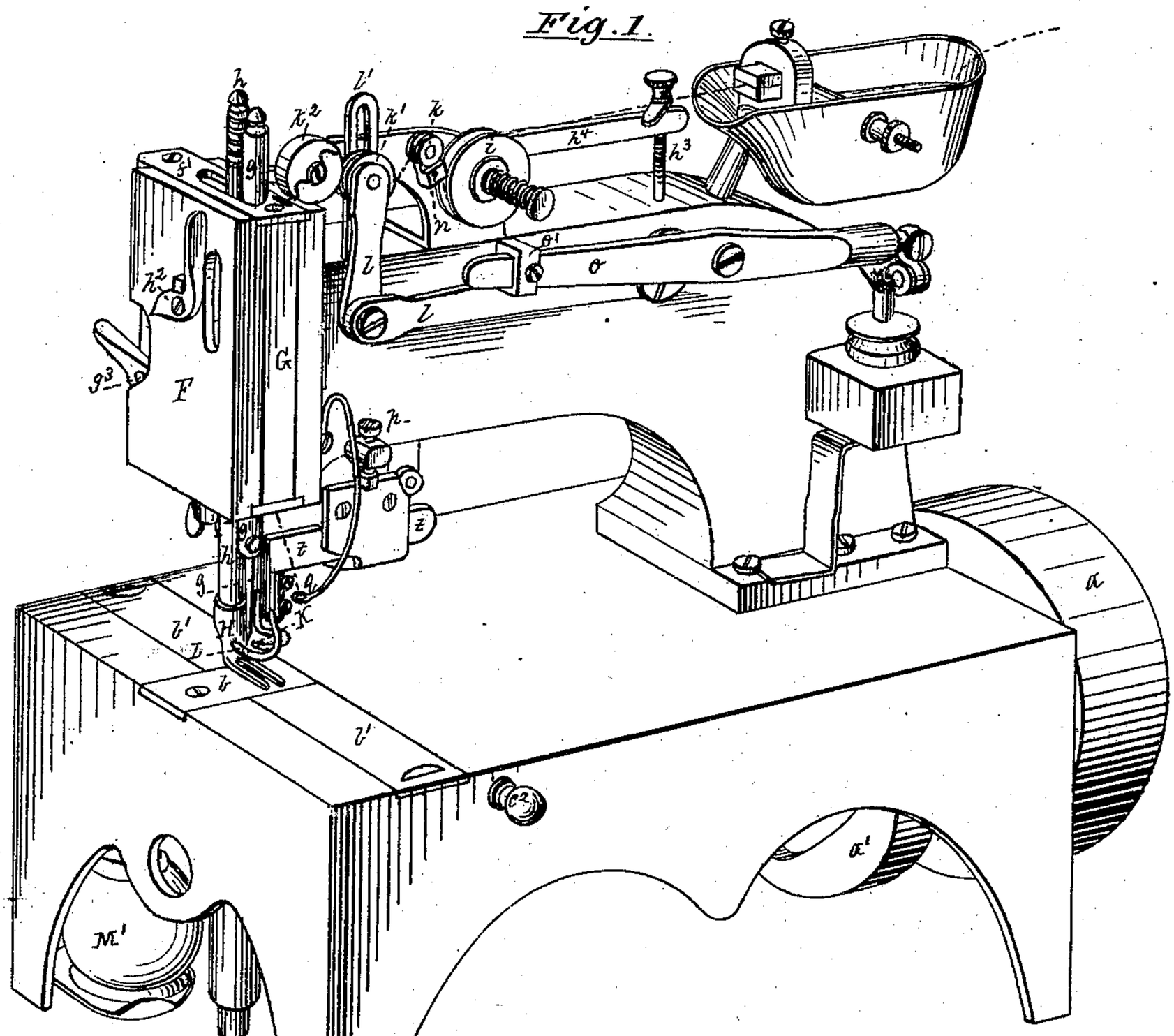


Fig. 3.

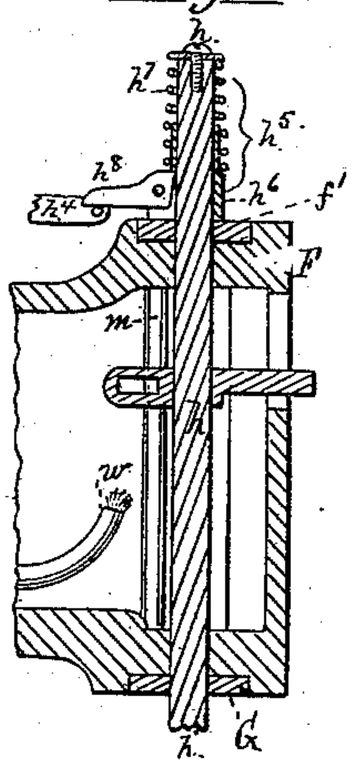


Fig. 6.

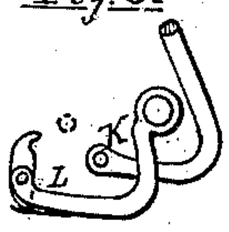


Fig. 7.

Fig. 4.

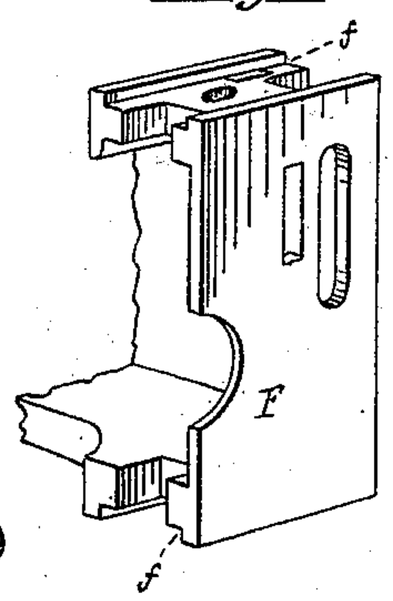
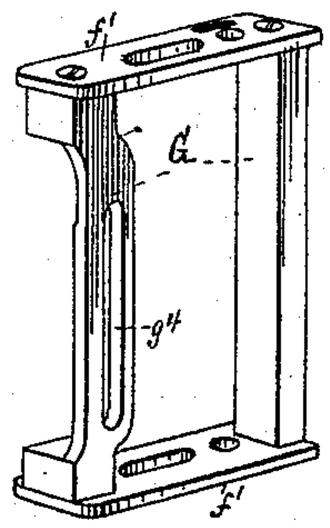


Fig. 5.



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2 Sheets--Sheet 2.

D. H. CAMPBELL.

Sewing Machine.

No. 231,954. Patented Sept. 7, 1880.

Fig. 2.

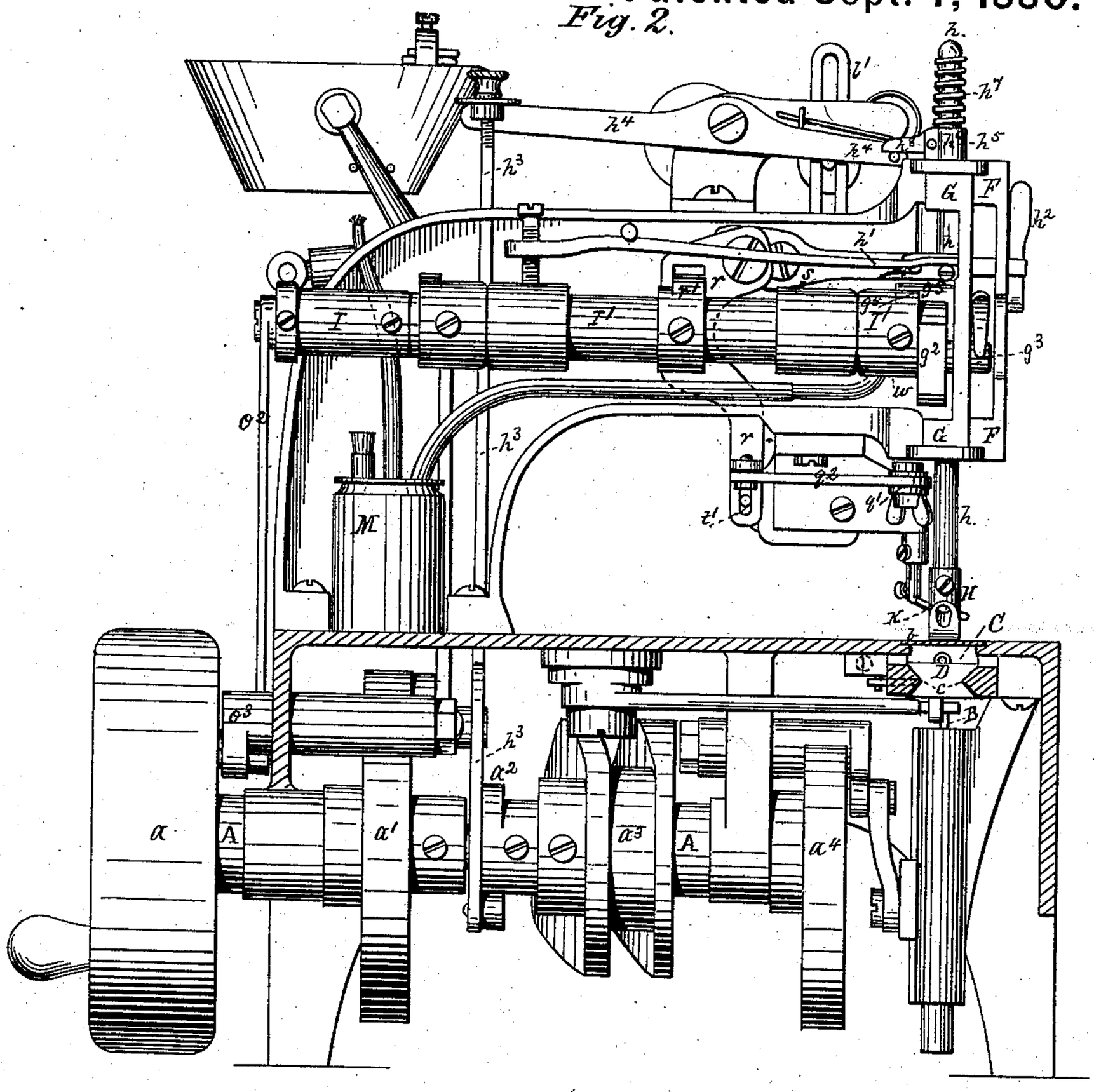


Fig. 8.

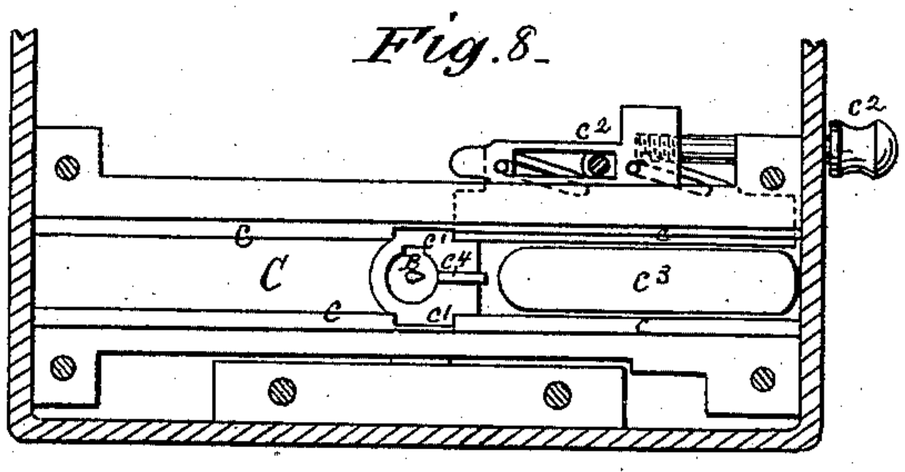


Fig. 9.

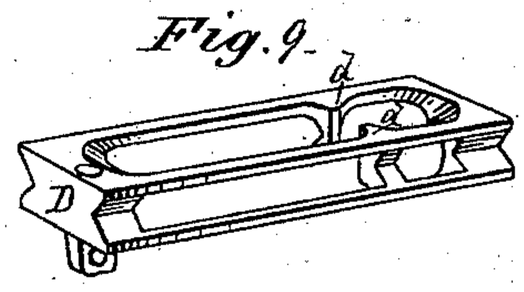


Fig. 10.

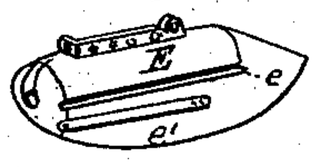


Fig. 11.

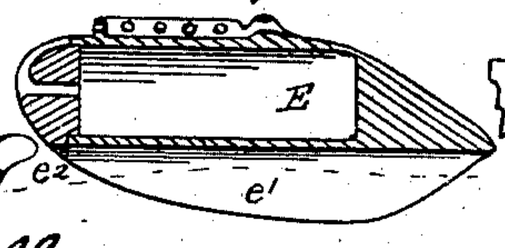
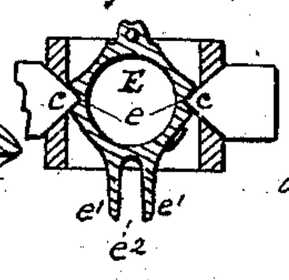


Fig. 12.



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UNITED STATES PATENT OFFICE.

DUNCAN H. CAMPBELL, OF PAWTUCKET, RHODE ISLAND, ASSIGNOR OF THREE-FOURTHS OF HIS RIGHT TO HENRY B. METCALF, FRANK E. COMEY, AND DANIEL McNIVEN, OF SAME PLACE, ONE-FOURTH TO EACH.

SEWING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 231,954, dated September 7, 1880.

Application filed January 30, 1878.

To all whom it may concern:

Be it known that I, DUNCAN H. CAMPBELL, of Pawtucket, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Sewing-Machines; and I do hereby declare that the following specification, taken in connection with the drawings furnished and forming a part thereof, is a clear, true, and complete description of my invention.

My said improvements have been applied by me to machines for sewing with waxed thread, and they will be described as embodied in a lock-stitch machine of the wax-thread class having a hook-needle and an awl.

I employ in my machine a hooked needle and a centrally-pointed shuttle. The shuttle is novel in its construction, in that it has its point in line with its longitudinal center, has a longitudinal score, preferably V-shaped, in each of its sides, and a longitudinally-slotted web at its under side, whereby when the shuttle enters a loop previously mainly drawn down by the needle it spreads the loop equally on both sides, and passes through it in contact therewith at four separate points—one on each side of the shuttle and one on each side of the slotted web—and the V-shaped recesses being occupied by correspondingly-shaped ways in the shuttle-race, the shuttle is enabled to draw downward such additional thread as may be requisite to afford its passage.

Although my shuttle is centrally pointed, its point is truly angular and lance-shaped, which enables it to enter its loop without liability of piercing the thread of which the loop is composed. The lance-edge of the shuttle is slightly below its longitudinal central line, and it is therefore enabled to enter the loop at its widest point, which is always immediately above the needle, and no obstruction to the passage of the shuttle is offered by the needle the moment its point is carried below the lance-shaped point of the shuttle, because the webs on the shuttle afford the longitudinal recess which is occupied by the hook of the needle as the shuttle passes over it.

The shuttle-race supports the shuttle independently of the carrier by means of inwardly-projecting ways, preferably V-shaped in section, which occupy similar longitudinal recesses in the shuttle, and which are broken away at each side, adjacent to the middle of the race, opposite the path of the needle. The shuttle-race being thus broken away affords a free space for each side of the loop during the passage of the shuttle, and the projecting ways limit the shuttle to a longitudinal movement.

I hereinafter make claim to certain limited combinations, embracing a hook-needle, a race-way, and a centrally-pointed shuttle; but it is to be understood that I make no claim, broadly, to those elements in combination, because the oldest sewing-machine of which I have knowledge embodied them in connection with mechanism for operating the needle and shuttle and for delivering and controlling the upper or needle thread. Said old machine is shown and described in English Letters Patent No. 12,221 of A. D. 1848.

My improvements have been made with special reference to the production of a wax-thread sewing-machine embodying those elements, which would be capable of operating at a high rate of speed with a smooth and easy motion, a heavy shuttle-tension, and with but little frictional exposure of the wax-thread loop.

My shuttle has already been described. It differs from said old shuttle in having two longitudinal webs on its under side; but said old shuttle had a longitudinal recess in its under side, which was occupied by the point of the needle as the shuttle passed over it. My webs afford a similar recess; but it has greater depth, and therefore allows the needle to rise therein for casting off the loop; and said webs also serve to hold the loop away from the body of the shuttle, instead of allowing it to be in full contact therewith; and they also enable me to obtain the desired needle-recess without diminishing the interior capacity of the shuttle for receiving thread. My shuttle has also a longitudinal groove on each side; but this feature, in itself, is not broadly new, it having before been used in a flat-sided shuttle for use with an eye-pointed needle.

My shuttle-race has also been before herein

referred to; but such a race is not broadly new, for a race composed of parallel ways which occupy grooves in the sides of a flat-sided shuttle has heretofore been employed with an eye-pointed needle, and said prior race was also broken away on each side, as in my machine.

Shuttles of various forms have heretofore been used with needles of various kinds in wax-thread machines; but they have been so constructed and combined with races of such a kind as to require special mechanism of some kind for aiding the shuttle to properly pass through its loop as presented by the needle, because of the stiff, heavy, and adhesive character of the waxed thread employed.

One portion of my improvements consists in the combination, with suitable operating mechanism, of a hooked needle, the centrally-pointed shuttle having longitudinal grooves in its sides, and the shuttle-race composed of fixed parallel ways which project inwardly, occupy the grooves in the shuttle, and are broken away at or near the middle of the race. These elements thus specified constitute in my machine an operative combination for drawing down a wax-thread loop, passing the shuttle through the loop, and interlocking the shuttle-thread therewith without the aid of any additional mechanism for spreading the loop or releasing it from the needle; and the same is true of the old machine referred to; but in my machine the shuttle moves on parallel ways, which, while they rigidly confine the shuttle to a longitudinal movement, also so engage therewith as to admit of a smooth, easy, and rapid movement throughout its entire stroke, and the shuttle itself has even less frictional contact with the loop than in said prior machine. The lubricated surfaces of the shuttle, being recessed, are not liable to oil the loop, and thereby injure the waxing. The race being broken away at the sides for affording a stop for the loop permits the needle to be released therefrom as soon as the shuttle enters it, thus relaxing strain on the loop and promptly affording a free passage for the shuttle.

For removing the shuttle from its race a portion of one of its inwardly-projecting ways is laterally movable, being mounted on a slide and controlled by a sliding rod, whereby it may be retired out of engagement with its shuttle; and that particular construction constitutes another portion of my improvements.

Another improvement consists in the combination, with the longitudinally-grooved and centrally-pointed shuttle and the race composed of inwardly-projecting fixed parallel ways which occupy grooves in the shuttle and are broken away at or near the middle of the race, of a rectangular shuttle-carrier which is mounted upon said parallel ways and is provided with oppositely-located fingers for engaging laterally with opposite shoulders of the shuttle.

In this connection I do not claim to have invented a rectangular shuttle-carrier mounted on ways, nor one which laterally engages with the opposite shoulders of a shuttle; but such a carrier mounted on shuttle-ways which are parallel throughout their length, and which occupy recesses in the sides of a centrally-pointed shuttle for wax-thread sewing, is novel with me.

In my machine this driver has a peculiar value, because it is a reliable form of shuttle-driver for operating, at high speed and under heavy tension on its waxed thread, a shuttle which is alone relied upon for opening its loop and is rigidly limited to a longitudinal movement during its passage through its loop at each end of its stroke for properly securing the requisite degree of tension on its thread and the proper delivery of thread for a new stitch.

Another improvement consists in the combination, with the longitudinally-grooved and centrally-pointed shuttle, the hooked needle, and the race composed of parallel ways which occupy grooves in the shuttle and are broken away at or near the middle of the race, of a shuttle-carrier which entirely surrounds the shuttle longitudinally and laterally and loosely engages with its heel and shoulders.

In this connection I do not claim to have invented a shuttle-carrier which entirely surrounds a shuttle, for such a carrier has heretofore been employed in combination with a shuttle and an eye-pointed needle. In the specifically limited combination last stated by me as a part of my improvement such a carrier has a peculiar value, because the front end of the carrier rigidly braces its sides at its points of contact with the shoulders of the shuttle, which, when operated at high speed and under considerable tension on its comparatively stiff and waxed thread acts as a wedge forcibly entered between the fingers of the driver at the termination of each rearward movement, and when not thus braced the shuttle and fingers are liable to be so firmly united by the springing of the fingers as to prevent the proper operation of the shuttle in its next forward movement. I have embodied these novel features in a machine having an awl which punctures the material on the work-plate, and also performs the "feeding" function. The feeding may, however, be accomplished by a complex movement of the needle, as heretofore, or by any other well-known mechanism for performing that service. In my new machine I also employ certain novel mechanism in connection with delivering the thread to the needle; but any well-known thread-delivery mechanism may be employed in the combination specified.

As it is desirable that the shuttle should be well tapered at its front, and as the shuttle enters the loop before the needle has passed fully below the shuttle, I provide an upwardly-projecting stop centrally located within the race, which when the shuttle advances occupies the groove between the webs of the shut-

tle on its under side, and prevents the lower end of the loop from moving forward with the shuttle; and my invention further consists in the combination, with a hook-needle, of a centrally-pointed shuttle provided on its under side with longitudinal webs separated by a groove, and an upwardly-projecting permanently-fixed stop within the shuttle-race, which occupies the groove in the shuttle in its passage over said stop.

As heretofore constructed a thread-eye and a thread-arm have been so combined that the thread is delivered to the hook of the needle in the form of a bight, and although these elements are employed by me, they operate in my machine in a novel manner, in that they are so constructed and combined with the presser-foot that in proportion as the latter is located above the work-plate by the thickness of the material on the plate, the operation of the thread-arm will vary as to the length of thread drawn down by it for presentation to the hooked needle. In other words, the thread-eye and thread-arm so co-operate that the quantity of thread drawn down and presented to the needle will be automatically varied in accordance with the thickness of the material which is being stitched; and in this connection my invention further consists in the combination, with a hooked needle and presser-foot, of a thread-eye and a vibrating thread-arm which is connected with and controlled by the presser-foot. This portion of my invention is not limited to a shuttle-machine, nor to one in which a separate awl is employed, because it is applicable to any machine in which the hook-needle is used.

For the purpose of securing the return movement of the thread-arm without liability of abrading the standing thread of the loop as it is being drawn down by the needle my thread-arm is jointed and provided with a spring, so that it is rigid when moving forward and flexible when moving backward, and this jointed thread-arm, in combination with a hook-needle and a thread-eye, constitutes another portion of my invention.

In my improved machine the thread-eye is also controlled, as to the extent of its vibratory movement, by the presser-foot, and by having both the thread-eye and the arm thus controlled it assures the presentation to the needle of the thread, which extends from the eye to the arm, at a point always about midway between the eye and arm, whether they be widely separated and at their extremes of movement or otherwise, thereby enabling the needle to pass downward without causing the thread to slip in the hook; and my invention further consists in the combination, with a hook-needle, of a vibrating thread-eye which is varied with relation to the extent of its vibratory movement by the location of the presser-foot with relation to the work-plate.

In wax-thread machines it is not new to impart a positive lift to the presser-foot during the feeding movement; but I have devised a novel combination of mechanism, which is of special value in machines in which the feeding is effected by the lateral movement of a vertically-reciprocating awl which co-operates with a vertically-reciprocating needle, these being located, respectively, above and below the work-plate. Said combination consists of the presser-foot, its holder, the main shaft, and a cam thereon, a self-adjusting spring-clamp on the presser-foot holder, a horizontal spring-lever which engages with the clamp, and a threaded rod and its adjusting-nut for operatively connecting the cam on the main shaft with the horizontal spring-lever. The threaded rod and its adjusting-nut admits of varying the height of lift of the presser-foot during the feeding movement.

As heretofore constructed lock-stitch wax-thread machines have been provided with mechanism for positively controlling the surplus thread of a loop after the passage of the shuttle; but I have devised a simple and effective "take-up," which is operated from the main shaft, and is capable of varied adjustment, so as to locate the junction of the two threads at any desired point within a single thickness of material, or at any desired point between the upper and lower surfaces of a pile composed of several layers of leather or other material capable of being stitched. This portion of my invention consists in the combination of suitable tension devices which will properly deliver thread to the needle for the formation of a loop with a lever provided with a thread-wheel and an operating-lever which is positively vibrated at intervals by its connection with the main shaft, and which engages with the thread-wheel lever for forcibly vibrating it sufficiently to take up the surplus thread after the passage of the shuttle and tighten the stitch.

For variably limiting the movement of the thread-wheel lever, my invention further consists in the combination, with said lever, of an adjustable abutment. When running at full speed the thread-wheel lever is liable by its impetus to unevenly draw the stitches; but the abutment referred to overcomes its impetus, and the location of the junction of the loop and shuttle threads is thereby assured with uniformity at any desired point within the material.

For attaining a heavy strain on the take-up when using heavy thread on thick work, I employ a tension-wheel, which will freely deliver thread, (when the thread-wheel lever is not under the control of the operating-lever,) and combine therewith a brake which is operated by the thread itself whenever the thread-wheel lever is driven downward by its operating-lever.

It is important that the waxed thread be smoothly delivered to the needle, and this can only be attained when the thread is well heated.

Heretofore a thread-tube has been employed outside the head of the machine on its front face, which could only derive such heat as might be radiated through the head and thence through the tube. The exposed position of the tube and the interior upward currents of air incident to such heating, as is possible even with such a construction, renders it difficult to maintain the waxed thread in a desirably heated and flexible condition. To overcome this difficulty I provide within the head of the machine a tube which extends from top to bottom thereof, nearly in line with the path of the needle, and which is directly exposed to the heating apparatus, and such a thread-tube within the head of a sewing-machine and directly exposed to the heating apparatus constitutes another feature of my invention. My thread-tube, instead of being outside the head, as heretofore, is wholly inclosed within the head, and it is therefore capable of being well heated.

For affording great strength and securing durability to the feeding mechanism whereby the awl is moved laterally to and fro, my invention further consists in a solid head, channeled at top and bottom, in combination with the awl-bar slide, which is mounted therein and provided with upper and lower guides or guide-plates, occupying, respectively, the upper and lower channels in the head. These guide-plates also afford bearings for the awl-holder.

To more particularly describe my invention I will refer to the accompanying drawings, of which there are two sheets.

Figure 1, Sheet 1, is a perspective view of a machine embodying my invention. Fig. 2, Sheet 2, is an elevation thereof, with the side of the frame removed for exposing the main shaft. Fig. 3, Sheet 1, is a sectional view of the head of the machine, the feed-slide, and presser-foot holder. Fig. 4, Sheet 1, is a perspective view of the head of the machine broken from the main frame and without the feed-slide. Fig. 5, Sheet 1, is a perspective view of the feed-slide detached. Fig. 6, Sheet 1, represents the relative positions to each other of the thread-eye and thread-arm when the needle is at its lowest position, its path being indicated in dotted lines. Fig. 7, Sheet 1, represents the thread-arm and thread-eye in the positions occupied by them just prior to the descent of the needle with the thread in its hook. Fig. 8, Sheet 2, represents the shuttle-race in top view. Fig. 9, Sheet 2, represents, in perspective, the shuttle-carrier. Fig. 10, Sheet 2, represents the shuttle in perspective. Fig. 11, Sheet 2, represents the shuttle enlarged and in longitudinal central section. Fig. 12, Sheet 2, represents the shuttle and the carrier in lateral section, as if mounted on the ways of the shuttle-race.

The main shaft is shown at A, and it is provided with a balance-wheel, *a*, in the side of which is a cam-groove for operating the tension devices and the feed-motion; a side-grooved cam, a', for operating the awl-bar, the thread-eye, and thread-arm; a cam, a^2, for lifting the presser-foot during the feeding movement; an edge-grooved cam, a^3, for operating the shuttle, and a side-grooved cam, a^4, for operating the hooked needle.

B denotes the hooked needle, which is vertically reciprocated in a slide, as usual, beneath the work-plate by means of the connection of its holder with the cam a^4, substantially as heretofore. Its cam is so shaped that the needle is moved fully upward, thence fully downward below the point of the shuttle, thence slightly upward, and then rests until the next movement.

C denotes the shuttle-race, which extends transversely across the machine. A work-plate, *b*, as heretofore, is located over the center thereof, is provided with a needle-slot and a screw, by which it is secured in position. Two sliding plates, b', cover the remainder of the race and render it accessible from above. The race on each side is provided with a projecting way or spline, *c*, which, in section, is preferably V-shaped, and at a central point each way is removed, as at c'. One portion of said way *c* is fitted to slide laterally within a recess, and is provided with cam-slots, which are occupied by pins on the sliding rod c^2, so that by pulling said rod outward longitudinally said portion of the way *c* is withdrawn into its recess and forced outward by the return movement of said rod, thereby affording a means for removing the shuttle from the race, as will hereinafter be described. The splines or ways *c*, although fixed with relation to the shuttle, are secured to the frame of the machine by means of slots and screws which admit of adjustment, so as to permit the accurate location of the shuttle with relation to the needle, and also so as to provide for compensating for wear from time to time. At one end of the race, opposite the movable way and below it, is a shuttle-table, c^3, on which the shuttle may rest while being inserted into working position, and which prevents it from falling when the movable-way spline is retired. The needle-bar post is provided with an upwardly-projecting stop, c^4, which is located in front of the hook side of the needle and occupies a central position in the shuttle-race, as seen in Fig. 8.

D denotes the shuttle-carrier. It is in this instance grooved on each side longitudinally for engaging with the splines or ways *c*, before described. It is rectangular in form and incloses the shuttle on each side and at both ends, but it in no manner supports the shuttle. It abuts with the heel of the shuttle, and has two oppositely-located fingers or projections, *d*, which laterally engage loosely with the shoulders of the shuttle, so that the carrier will be capable of a slight longitudinal movement without moving the shuttle. The shape of its cam a^3 is such that the carrier is moved

forward abreast of the needle, then rests, then moves to end of its stroke, then slightly reciprocates for easing the loop over the rear end of the shuttle, and then returns, substantially as heretofore. I sometimes mount this carrier independently of the splines or ways in the shuttle-race by providing independent slides or supports therefor, and this relieves the ways *c* from any wear other than that incident to the movement of the shuttle thereon.

E denotes the shuttle. It is hollow, has a detachable heel or cover secured by a spring, and a perforated tension-web on top, substantially as heretofore. It is also provided on each side with a longitudinal score or groove, *e*, for receiving the ways or splines *c* in the shuttle-race. These scores correspond in form with the form of the shuttle-race splines, and are preferably V-shaped. The point of the shuttle is in line with its longitudinal center, and preferably slightly below the lateral center thereof, as shown. It has on its under side two webs, *e'*, which extend from the point to the heel of the shuttle, and are separated by a space, groove, or channel, e^2, which is wider than the diameter of the needle employed therewith. The point of the shuttle is incapable of piercing the thread of the loop, because it is lance-shaped and because the shuttle-point enters the widest portion of the loop—*i.e.*, the portion immediately above the needle—this latter being wholly out of the way of the shuttle the moment the point of the needle is moved below the point of the shuttle, because the longitudinal recess between the webs of the shuttle affords a space to be occupied by the needle during the forward passage of the shuttle over it. As will appear from the lateral section, Fig. 12, the shuttle, while passing through a loop, engages therewith only at the two sides and at the edge of each web, thus but slightly exposing the loop to abrasion. The shuttle, when in the race within the carrier, is supported wholly by the splines *c*, and the carrier has an abutting contact at the rear and also on each side of the shoulder of the shuttle.

The stop c^4, before described, occupies a portion of the path of the shuttle, in that it projects upward within the groove between the webs. The loop having been nearly drawn down by the needle, the point of the shuttle then enters immediately above the needle, the point of the latter occupying the recess in the shuttle, and as soon as the shuttle is well entered into the loop the needle rises slightly and thereby releases the loop from the hook. The lower end of the loop, moving forward slightly with the shuttle and away from the needle, because of contact with the webs of the shuttle, is then engaged by the stop c^4, which prevents the undue forward movement of that part of the loop with the shuttle, because said stop is located in front of the needle and occupies the recess in the shuttle during the movement of the latter above it. The shuttle is easily removed from the race after pulling the sliding rod c^2, which retires one portion of the spline *c* into its recess.

F denotes the head of the machine, which contains the presser-foot holder, the feed-slide, and the awl-holder. It is cast solidly with the neck, and is channeled at top and bottom, as at *f*, for the reception of the guide-plates *f'* of the feeding-slide G, in which the awl *g* and its holder *g'* is mounted. The feeding movement is effected by the awl, as heretofore, in a manner well known, and when it moves upward after puncturing and moving the fabric or leather it is exactly in line with the path of the needle.

The presser-foot H is, as usual, provided with a holder, *h*, which has slide-bearings in the head F, and the upper and lower guides, *f'*, of the feeding-slide are slotted, so as to afford spaces for the holder. The presser-foot is provided with the usual spring, *h'*, and the usual cam-lever, h^2, for lifting and retaining it preparatory to receiving work on the table.

The presser-foot is lifted at each feeding movement of the slide by means of a cam, a^2, on the main shaft, the vertical rod h^3, provided with a screw-thread and thumb-screw at its top for adjustment, a horizontal spring-lever, h^4, and a lever-clamp, h^5, which encircles the presser-foot holder *h*. The lever-clamp is composed of a band or sleeve, which loosely encircles the holder *h*, and a spiral spring, h^7, which, when the presser-foot is not lifted, forces the sleeve downward on the holder in contact with the adjacent surface of the feed-slide guide *f'*.

The clamp-lever h^8 is pivoted to the sleeve h^6, and is provided at its inner end with a cam-shaped surface, which causes it to firmly engage with the presser-foot holder *h* only when the cam on the main shaft operates thereon through the rod and horizontal spring-lever h^4, and when the lifting-pressure is removed from the clamp-lever h^8 the spiral spring h^7 is free to maintain the lever h^8 and sleeve at the lowest possible position in contact with the upper surface of the guide-plate *f'*.

The feeding-slide G is reciprocated to and fro for imparting to the awl *g* the lateral motion by which the material is moved for stitching by means of the rock-shaft I, which is actuated from the main shaft by means of the cam-groove in wheel *a*.

At the outer end of shaft I is a grooved arm, g^2, having an adjustable pin, g^3, which is provided with a lever, and occupies the groove in the arm, and also a vertical slot, g^4, in the feeding-slide G.

By adjusting the pin g^3 with relation to the axis of the rock-shaft in the groove of the arm g^2 and in the slot g^4 the extent of movement of the feed-slide may be varied, substantially as heretofore.

The awl-holder *g'* is reciprocated vertically by an arm, g^5, on the sleeve I', mounted on the rock-shaft I, and a connecting-link, as heretofore. This rock-shaft sleeve I' is actuated by the cam *a'* on the main shaft.

The machine is provided with the usual wax-cup, heated by suitable means, and the thread passes from the spool through the wax, and thence to the tension mechanism, as heretofore.

The thread in its delivery to the needle is subjected to the action of the ordinary tension-wheel *i*, which is, as heretofore, provided with a compressing-spring and adjusting-screw. The thread is passed usually once around said tension-wheel, and thence over a small pulley, *k*, thence beneath a shielded wheel, *k'*, mounted in the arm of a thread-wheel lever, *l*, thence upward over a shielded wheel, k^2, and thence downward within a tube, *m*, inclosed within the head F, and therein subjected to heat, as shown in Fig. 3.

For light sewing the thread-pulley *k*, being quite small, affords sufficient resistance against undue draft of thread from the spool when the thread-wheel lever *l* is depressed; but when intended for heavy sewing I employ the brake *n*, which is in the form of a lever centrally pivoted, has the pulley *k* mounted in one end thereof, and has its opposite end arranged to engage frictionally with the thread on the tension-wheel *i* whenever the thread-wheel lever is depressed for drawing up the surplus thread requisite for affording a passage for the shuttle through the loop.

The brake is provided with a lateral pin, by which it can be rendered inoperative for light sewing, if desired, and thereby permit the pulley *k* in itself to operate as a check on the tension, as before described.

The thread-wheel lever is depressed at the proper moment by its operating-lever *o*, which is pivoted to the frame of the machine, and is provided with the adjustable finger-plate *o'*, which engages, when moving downward, with the upper side of the thread-wheel lever. The operating-lever is actuated by means of a lever mounted on the rear end of the rock-shaft I, which is, in turn, connected by a rod, o^2, to a vibrating arm, o^3, pivoted to the rear side of the machine-frame, and provided with a stud and roller, which occupies the cam-groove in the side of the balance-wheel *a*.

The thread-wheel lever *l* has a vertical pivoted arm, at the end of which the shielded thread-wheel is mounted. A slotted guide, *l'*, is occupied by the axis of the thread-wheel on lever *l*, and secures to it a truly vertical movement.

Below the free end of lever *l*, I provide therefor a cushioned abutment, *p*, which consists of a screw housed in a lateral stud projecting from the frame of the machine. The head of the screw is recessed for receiving a cushion of leather or rubber, and the lower end of the screw is squared, so that it may be rotated by means of a wrench for accurately adjusting it and precisely limiting the extent of the downward movement of the thread-wheel lever.

The thread-wheel lever has sometimes been so constructed by me that its upward movement is relied upon to take up the thread, and this involves merely a modification in the construction and arrangement of its operative mechanism without departing from my invention.

K denotes the thread-eye, through which the thread passes from above on its way to the needle. A wire-guide, as at *q*, is interposed between the lower end of the tube *m* in the head and the thread-eye, as is common in sewing-machines. This thread-eye is mounted on a vertical shaft, which has at its upper end an arm, *q'*, and this, in turn, is connected by a link, q^2, with the lower arm of a bell-crank lever, *r*, which is pivoted to the end of a straight lever, *s*, which, in turn, is pivoted to the frame of the machine and connected at its opposite end with the presser-foot holder *h*.

The bell-crank lever *r* is slotted vertically for the reception of the end of an arm, *r'*, on the sleeve I' on rock-shaft I. The movement of the rock-shaft causes the bell-crank lever *r* to vibrate on its pivot to and fro and impart to the thread-eye a vibratory movement in the arc of a circle. When the presser-foot is raised it causes the farther end of the straight lever *s* to be depressed, and this virtually increases the throw of the bell-crank lever and correspondingly increases the throw of the thread-eye K.

I sometimes provide the bell-crank lever *r* with a spring for securing its return movement, but have in other cases relied upon the arm *r'* on the rock-shaft to effect that movement.

L denotes the thread-arm. It is sometimes made by me to move in the arc of a circle; but in this instance it is arranged to move in a right line to and fro, and is so formed that its shank passes above the thread-eye and its tip below it.

It is rigidly but adjustably mounted by means of a sleeve and set-screw on a downwardly-projecting stud, which is rigidly connected with a sliding bar, *t*, provided with guides in the frame of the machine. At the rear end of the sliding bar *t* is a lateral pin, which occupies a vertical slot, *t'*, in the lower end of the bell-crank lever *r*, from which it derives its movements. When the awl is nearly elevated the thread-eye stands at the rear and the thread-arm in front of the needle-slot, as shown in Fig. 6; but when the needle comes upward the eye and arm approach and pass each other, the eye swinging around and delivering the thread to the hook of the needle. The thread-arm, meantime, with its recessed tip *u*, engages with the thread, and draws it downward by a rearward movement, as indicated in Fig. 7, after which they both resume their original positions. The thread-arm in its backward movement passes across the path of the needle, which is occupied by the standing thread of the loop, and in order that it shall pass the thread without undue abrasion

the tip *u* is stop-jointed and provided with a back-spring, which renders the thread-arm rigid when moving backward with the thread and flexible when returning, so that it may readily pass the standing thread.

It will be seen that the thread-eye and the thread-arm (being both operated through the bell-crank lever *r*) will be variably moved according to the degree to which the presser-foot is elevated, and that therefore the quantity of thread measured off and presented to the needle will always be proportionate to the thickness of material to be stitched. It is not always necessary that the movement of the thread-eye be varied, provided the thread-arm be thus operated.

In stitching thin material I am enabled to attain very satisfactory results without using the thread-arm, and when not desired it can be readily removed.

Having in connection with the detailed description fully set forth the function and operation of the several parts, the operation of the machine as a whole will be readily understood.

I employ usually one main heating-lamp, M, with branch tubes, one of which terminates beneath the wax-cup, and the other at *w* within the head F, which thoroughly heats the tube *m* and the thread therein, as seen in Fig. 3. Another lamp, M′, is also located below the shuttle-race for heating the wax-thread cop within the shuttle; and sometimes a third lamp is employed, located beneath the wax-cup. Any suitable heating apparatus may be employed without in any manner affecting my invention.

In practice with my machine there is no liability of the undue accumulation of wax, either on the shuttle or in the race, and it will be seen that the thread at no point is unnecessarily subjected to abrasion.

Except as hereinbefore specifically limited, and as reiterated in certain of my claims hereunto annexed, I do not limit my invention to the precise construction of the several parts of my machine shown and described, for I am well aware from actual experience that many variations in construction and arrangement may be made without departing from many of the separately-stated features of my invention and without materially affecting the results.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. A sewing-machine shuttle having its point in line with its longitudinal center, a longitudinal recess at each side, and two longitudinal webs separated by a space or channel, substantially as described.

2. The combination of a hooked needle, the centrally-pointed shuttle having longitudinal grooves in its sides, and the shuttle-race, as described, composed of fixed parallel ways which project inwardly, occupy grooves in the shuttle, and are broken away at or near the middle of the race, and suitable mechanism for operating the needle and shuttle, all substantially as shown and described, whereby a loop is drawn down by the needle, entered by the shuttle, and released from the needle, and said shuttle firmly limited to a longitudinal movement in its race, as set forth.

3. A shuttle-race having inwardly-projecting shuttle-supporting ways or splines, a portion of which is mounted on a slide and controlled by a sliding rod, substantially as described, for the removal and insertion of the shuttle, as set forth.

4. The combination of the longitudinally-grooved and centrally-pointed shuttle, the race composed of inwardly-projecting fixed parallel ways which occupy grooves in the shuttle and are broken away at or near the middle of the race, and a rectangular shuttle-carrier mounted upon said parallel ways and provided with oppositely-located fingers for engaging laterally with opposite shoulders of the shuttle, substantially as shown and described, whereby the shuttle is passed through its wax-thread loop and firmly limited to a longitudinal movement during its passage through the loop and at each end of its stroke, while its thread is subjected to its greatest tension, as set forth.

5. The combination, with the longitudinally-grooved and centrally-pointed shuttle, the hooked needle, and the race composed of parallel ways which occupy grooves in the shuttle and are broken away at or near the middle of the race, of a shuttle-carrier which entirely surrounds the shuttle longitudinally and laterally and loosely engages with its heel and shoulders, substantially as shown and described, whereby the portions of the carrier which engage with the shoulders of the shuttle are firmly braced during the rearward movement of the shuttle and prevented from being sprung by the wedging action of the shuttle at the termination of its rearward stroke, as set forth.

6. The combination, with a hook-needle and a centrally-pointed shuttle having a longitudinal groove on its under side, of a vertically-projecting stop, centrally located and permanently fixed in the shuttle-race in front of the hook side of the needle, substantially as described, whereby the loop is formed, is opened equally, and prevented from moving forward with the shuttle, as set forth.

7. The combination, with a hook-needle and presser-foot, of a thread-eye, a vibrating thread-arm, mechanism for operating said arm, and devices by which it is connected to and controlled as to the extent of its movement by the presser-foot, substantially as described.

8. The combination, with a hook-needle and a thread-eye, of a thread-arm having a jointed spring-tip, which renders the arm rigid when carrying thread for presentation to the hook-needle and flexible when returning past the standing thread of a loop, substantially as described.

9. The combination, with a hook-needle and

presser-foot, of a vibrating thread-eye and operative mechanism which is connected with the presser-foot for varying the extent of the vibratory movement of the thread-eye by the location of the presser-foot with relation to the work-plate, substantially as described.

10. The combination, with the presser-foot, its holder, the main shaft, and a cam thereon, of a self-adjusting spring-clamp on the presser-foot holder, a horizontal spring-lever which engages with the clamp, and a threaded rod provided with an adjusting-nut which operatively connects the cam on the main shaft with the horizontal spring-lever, substantially as described, whereby the presser-foot is lifted during the feeding movement, and the height of lift graduated or adjusted, as set forth.

11. The combination, in a sewing-machine, with suitable tension devices which will properly permit the delivery of thread to a needle for forming a loop, of a thread-wheel lever and an operating-lever which, by engagement with the thread-wheel lever, positively actuates it at intervals for forcibly taking up the slack thread and tightening the stitches, substantially as described.

12. The combination, with a positively-vibrated thread-wheel lever, of an adjustable abutment which, by overcoming its impetus, limits the movement of said lever, substantially as described.

13. The combination, with a spring-tension wheel and a vibrating thread-wheel lever, of a brake which is operated by the thread and thread-wheel lever, substantially as described.

14. In a wax-thread machine, the combination, with the head thereof, of a vertical thread-tube located within the head of the machine and directly exposed to the heating apparatus, substantially as described, whereby the thread, as it is moved to and fro within the tube by the action of the needle and take-up, is maintained in a well-heated condition, as set forth.

15. A feeding-slide provided with upper and lower plates, which serve to guide the slide on the head and afford bearings for an awl-holder, in combination with a machine-head which is channeled at top and bottom for the reception of the guide-plates of the slide, substantially as described.

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Witnesses:

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