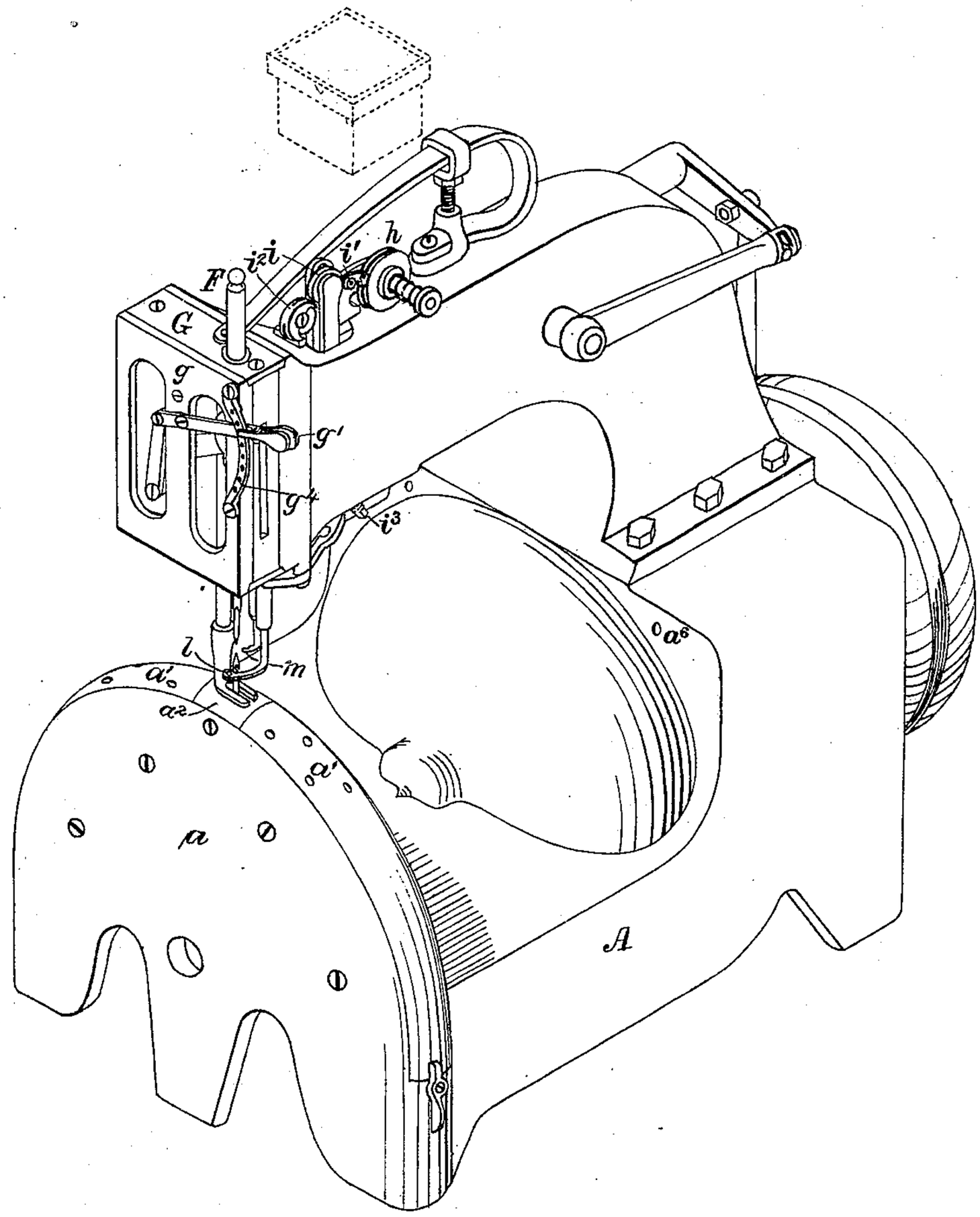
(Model.) 5 Sheets—Sheet 1.

D. H. CAMPBELL.

WAX THREAD SEWING MACHINE.

No. 253,156. Patented Jan. 31, 1882.

FIG. 1.



WITNESSES:

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Howell Bartle

INVENTOR:

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Attorney.

(Model.) 5 Sheets—Sheet 2

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WAX THREAD SEWING MACHINE.

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FIG. 2.

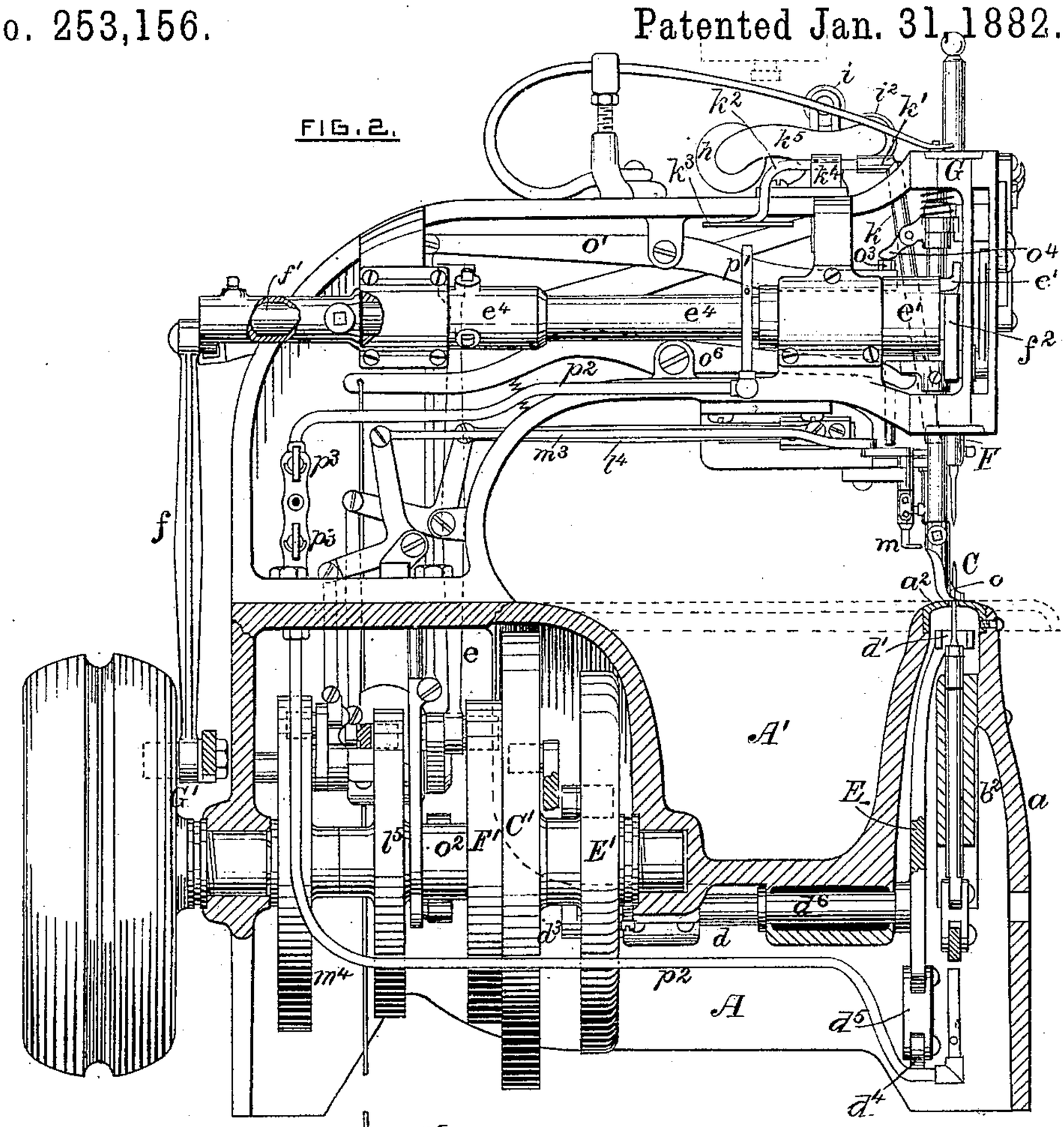


FIG. 3.

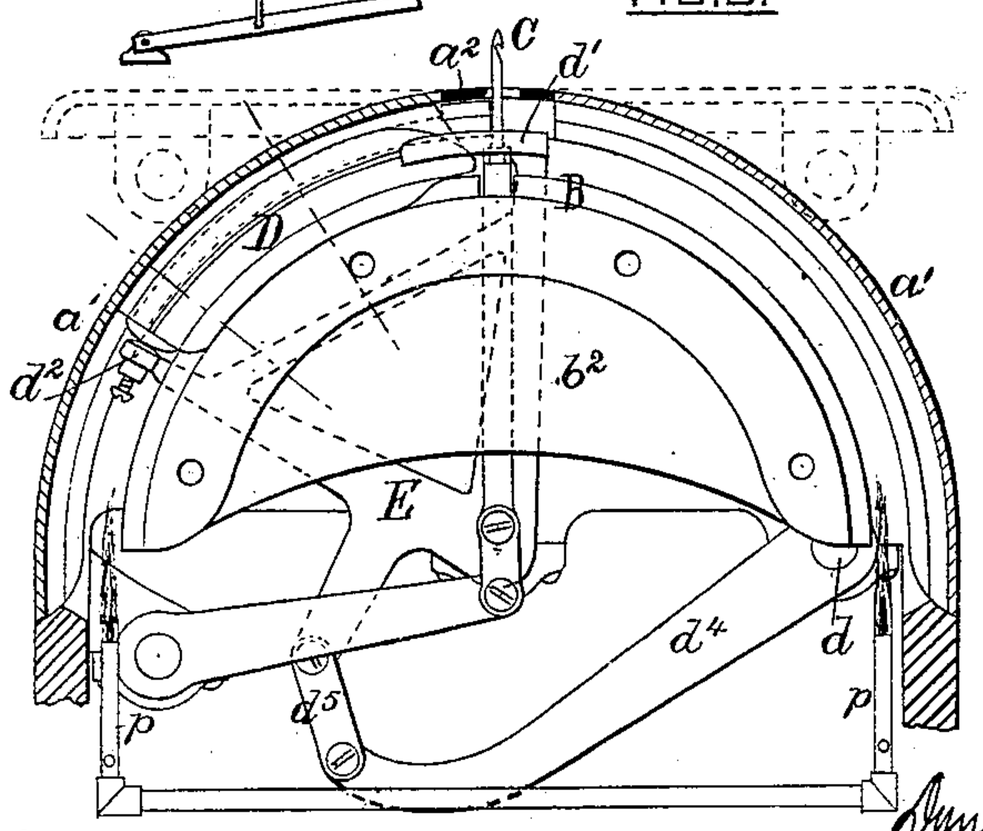


FIG. 4.

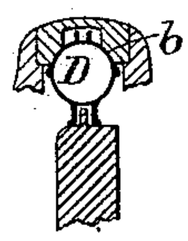


FIG. 5.

FIG. 6.

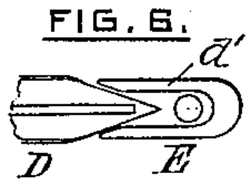
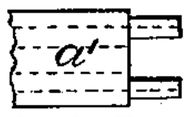


FIG. 7.



WITNESSES:

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(Model.) 5 Sheets—Sheet 3.

D. H. CAMPBELL.

WAX THREAD SEWING MACHINE.

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FIG. 8.

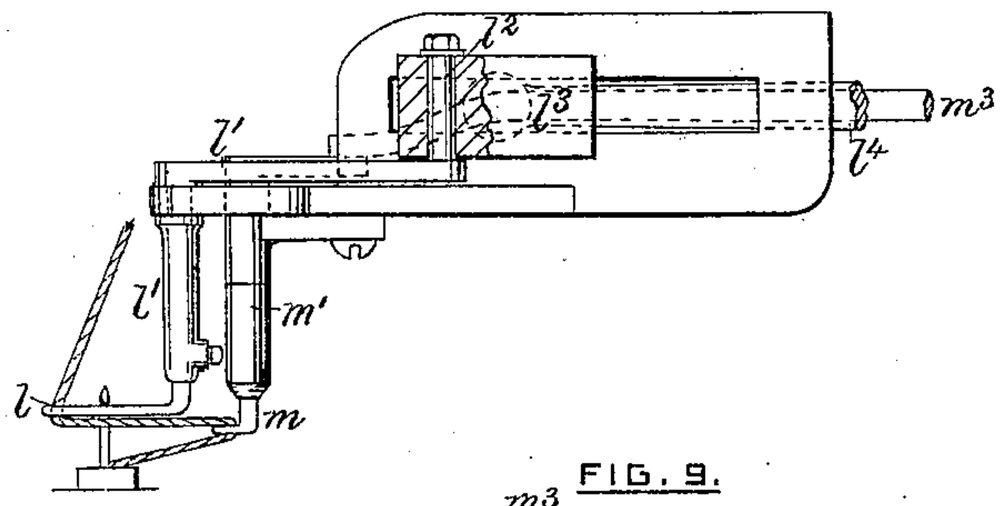


FIG. 9.

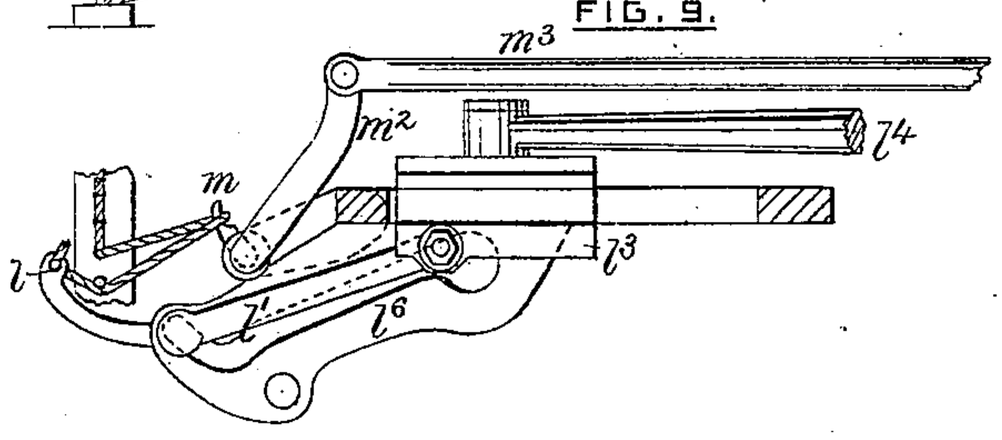


FIG. 10.

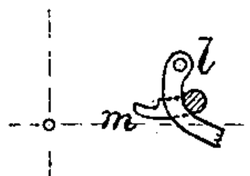


FIG. 11.

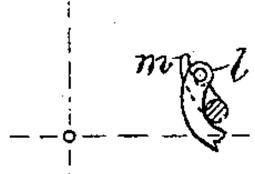


FIG. 12.

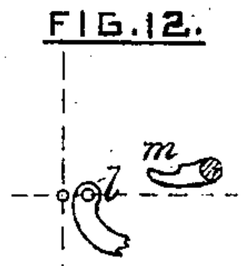


FIG. 13.

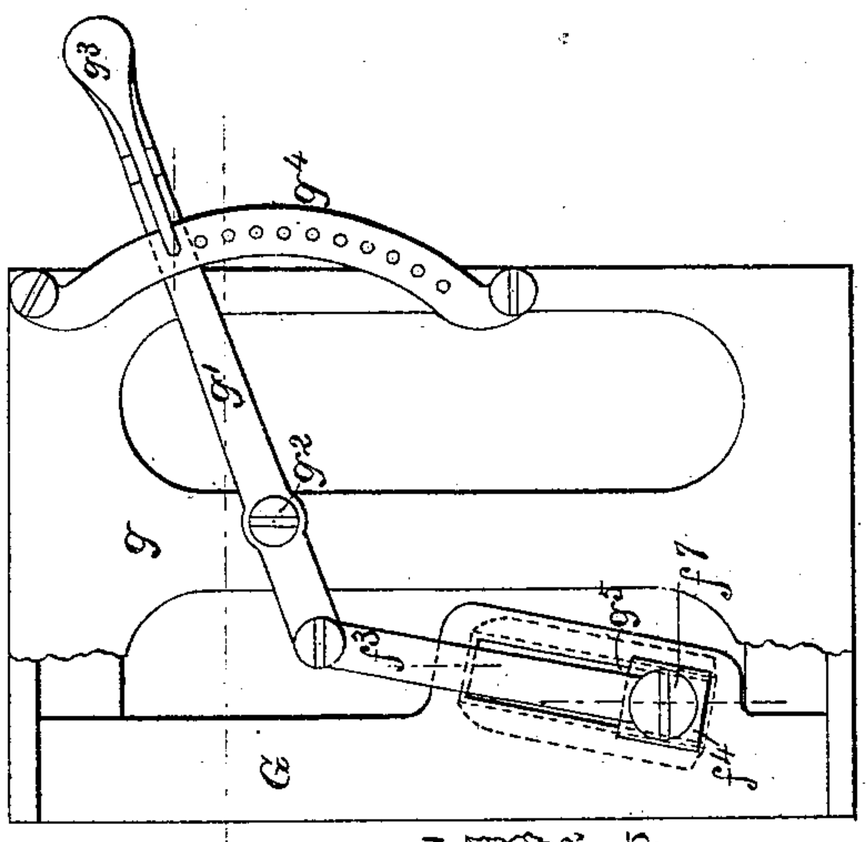


FIG. 14.

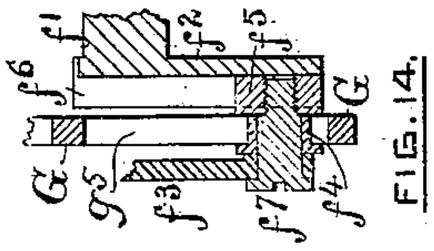
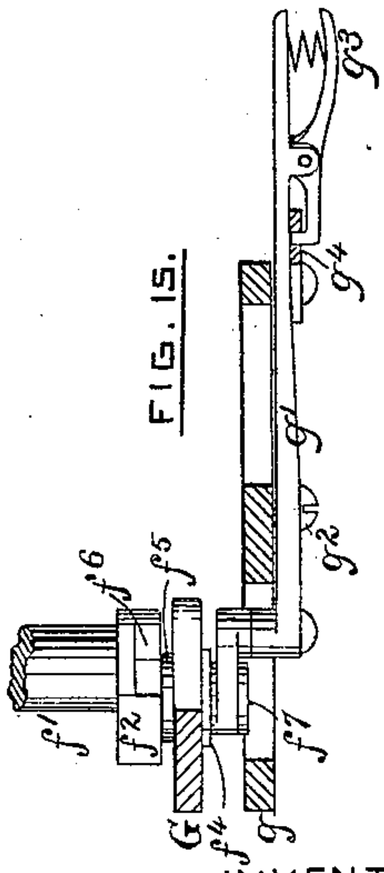


FIG. 15.



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(Model.) 5 Sheets—Sheet 4.

D. H. CAMPBELL.

WAX THREAD SEWING MACHINE.

No. 253,156. Patented Jan. 31, 1882.

FIG. 16.

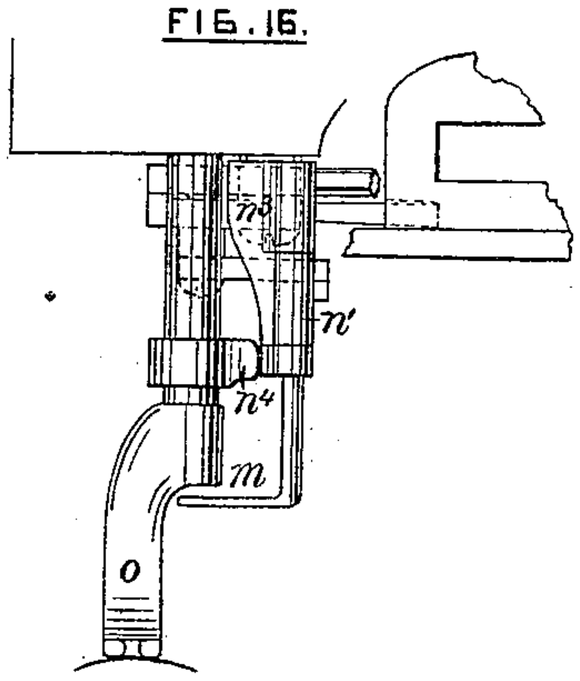


FIG. 18.

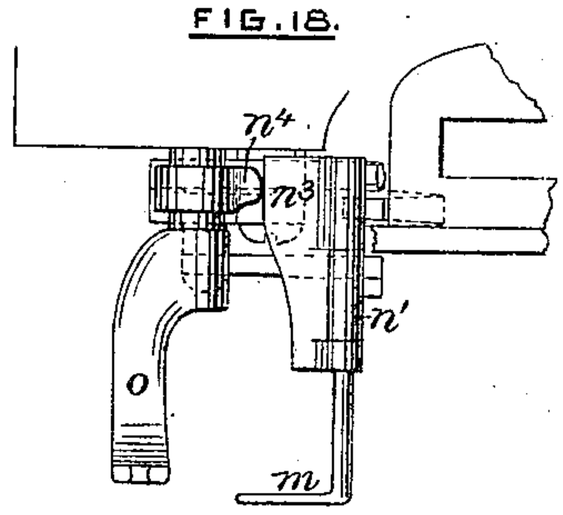


FIG. 17.

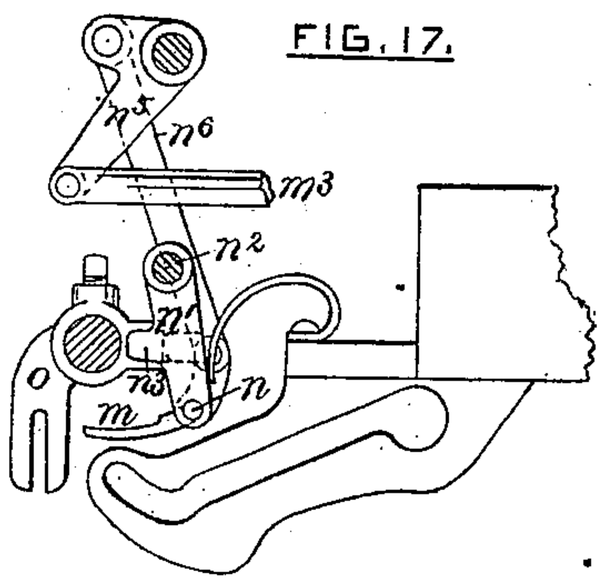


FIG. 19.

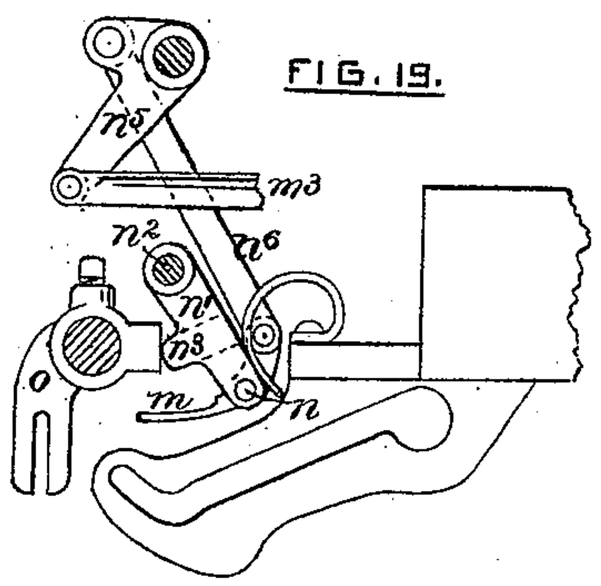


FIG. 20.

FIG. 24.

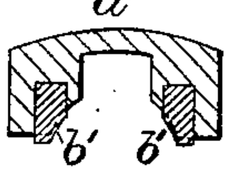


FIG. 21.

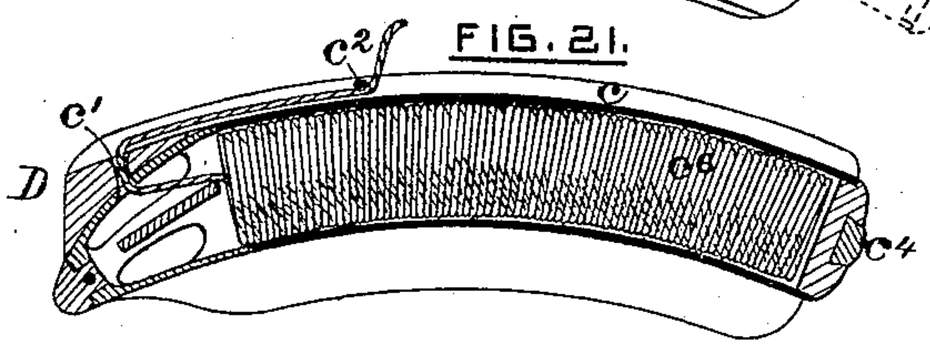


FIG. 23.

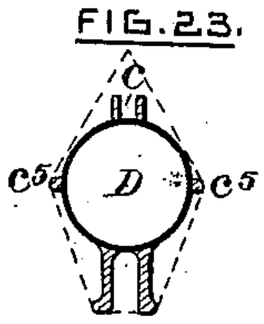
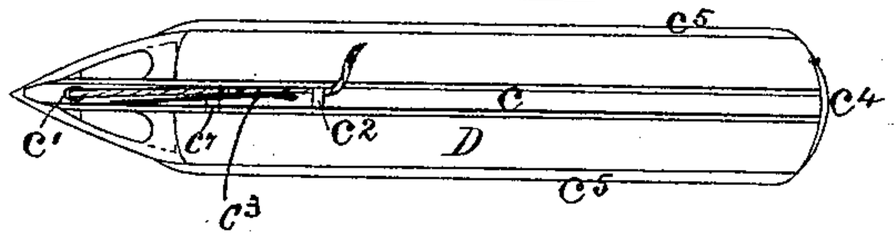


FIG. 22.



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(Model.)

5 Sheets—Sheet 5.

D. H. CAMPBELL.

WAX THREAD SEWING MACHINE.

No. 253,156. Patented Jan. 31, 1882.

FIG. 25.

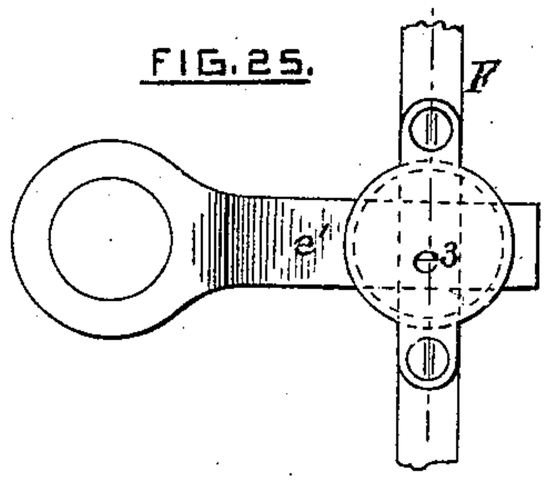
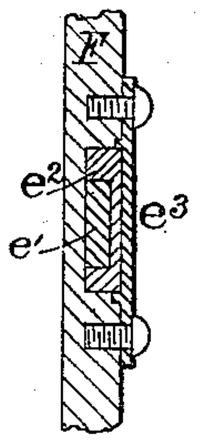


FIG. 28.



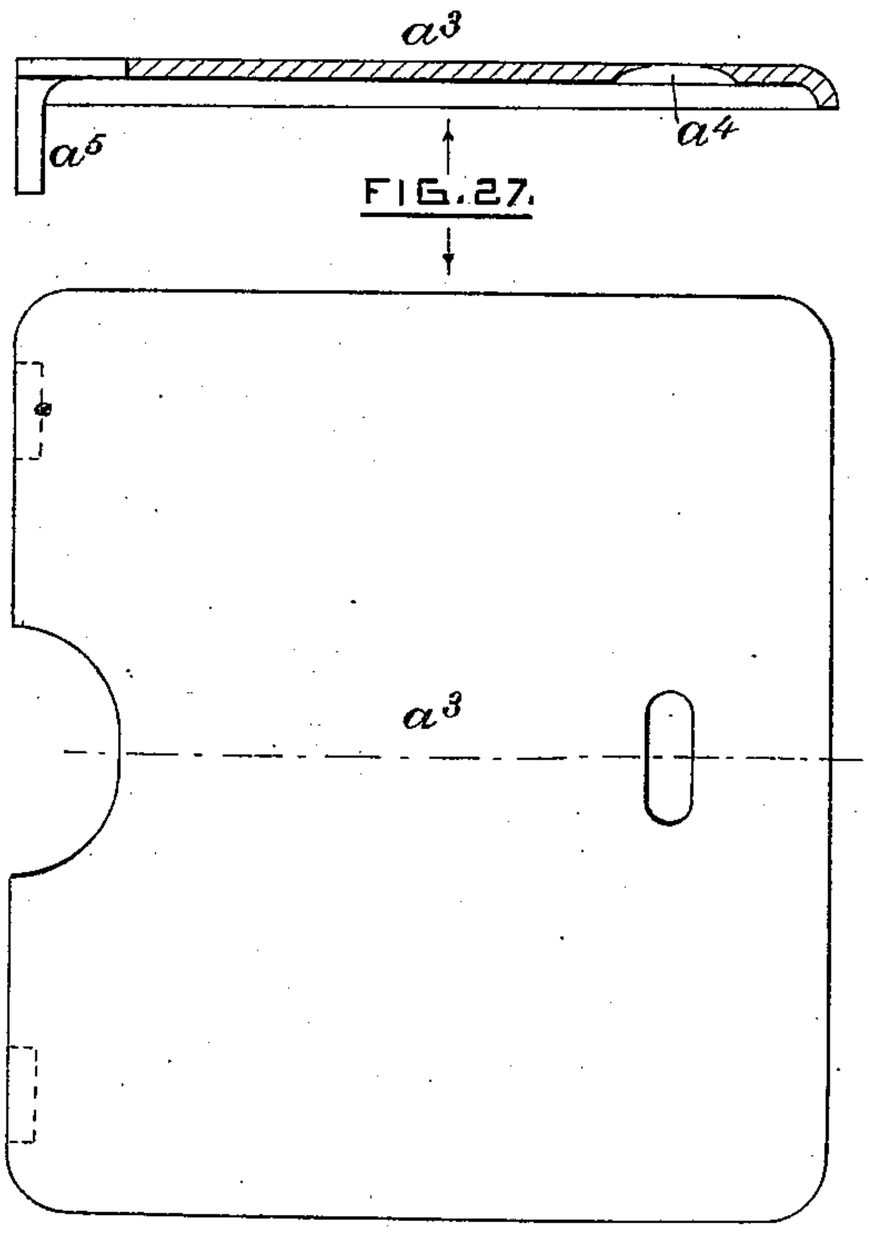


FIG. 27.

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UNITED STATES PATENT OFFICE.

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

WAX-THREAD SEWING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 253,156, dated January 31, 1882.

Application filed August 5, 1881. (Model.)

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 of the same, is a clear, true, and complete description of my invention.

My present improvements have all been employed by me in a machine for sewing with waxed thread, and they will be described as embodied by me in a lock-stitch machine having a hook-needle and an awl.

For adapting my machine to a wide range of service I have provided therefor an arch work-plate which is convex laterally and longitudinally, and have also so elevated and located the same with reference to the bed and other portions of the frame as to attain many of the advantages incident to the prior so-called "post-machines," together with such as accompany a flat work-plate, which can, if desired, be interchangeably employed on my machine as an attachment to the arch-plate.

For securing an unusual thread-carrying capacity in my shuttle, attaining an easy and effective motion therefor, and effectually heating the shuttle and its thread, I have provided a shuttle having a lance-shaped point and longitudinal webs on its under side, as shown in my prior Letters Patent No. 231,954, dated September 7, 1880; but instead of being straight, like all prior shuttles for wax-thread machines of which I have cognizance, my present shuttle is curved, so as to resemble a segment of a tubular ring, within which I can lodge upward of fifty yards of heavy thread, as four-cord No. 16, and of smaller sizes a much greater quantity, without an excessive cross-sectional area of shuttle. This shuttle may be made with comparatively light walls, and yet be reliably stiff and strong, because of its form; and although carrying a heavy load of thread, it is moved easily and effectively, because its path is in the arc of a circle in a vertical plane, and therefore, when operated at reasonable speed, it is lifted centrifugally from its rail and its driver. The race for the shuttle being arched and open below at each side, and also at the crown of the arch at the needle-hole in the work-plate, I utilize said race as a pair of heating-flues, up which, on each side, a current of heated air passes, the two currents meeting at the apex and passing outward through the needle-hole, thus not only properly heating the shuttle and its contents as it traverses the race, but also heating the needle and the upper waxed thread, which stands above and adjacent to the work-plate, and this, too, without appreciably heating the needle slide or bar and its bearings, which are located centrally and below the apex of the arch.

The race employed in this machine consists of a central rail occupied by the space between the webs of the shuttle and top guides, substantially in these respects as is shown and described in my prior Letters Patent No. 241,609, dated May 17, 1881; but my present race, as before herein indicated, differs from any other known to me in this class of machines, in that it is segmental in form.

For securing a smooth and easy action of the shuttle in its race, and providing for any undue pressure of the top of the shuttle against the top guides incident to centrifugal force, I have clad the top guides with non-metallic bearings, preferably of cork, or such other suitable material as will not be impaired by heat in the race, and which will be capable of cushioning the shuttle without undue friction therewith.

For properly controlling the slack shuttle-thread as the shuttle passes rearward, I have provided therefor a longitudinal recess or score on the upper side of the shuttle, and so proportioned a portion of the top guides of the race that they cause the slack shuttle-thread to house itself effectually within said top score.

I have provided a shuttle driver and operating mechanism which enables the driver to halt and retire a trifle while the loop is being drawn up, and then to advance for tightening the shuttle-thread. Said driver has two arms radiating upwardly from a rock-shaft located below and in line with the path of the needle and in line with the standing thread when drawn upon by the take-up.

Above the work-plate in my present machine I have provided many novel features

pertaining to the obviation of undue abrasion of the upper thread, well heating the same, its proper presentation to the needle, and the self-adjustment of devices for measuring off the thread requisite for a stitch, and also pertaining to the awl-operating mechanism and the feed graduation.

After fully describing in detail my improvements as embodied in the machine illustrated in the drawings, the several features deemed novel will be specified in the several claims hereunto annexed.

Five sheets of drawings illustrate as follows: Figure 1, Sheet 1, is a front and side view of a machine embodying my invention. Fig. 2, Sheet 2, is a side elevation of the same, but with the bed-frame in section. Fig. 3, Sheet 2, is an end view of the lower portion of the machine with the arch work-plate in section, and illustrates a flat work-plate applied as indicated in dotted lines. Figs. 4 and 5, Sheet 2, are sectional views of different portions of the race with shuttle in position. Fig. 6, Sheet 2, is a top view of the front portion of the shuttle and one arm of the driver. Fig. 7, Sheet 2, is a top view of one end of one of the race-plates detached. Figs. 8 to 12, inclusive, Sheet 3, are detail views of the mechanism for delivering thread to the hook-needle. Figs. 13 to 15, inclusive, Sheet 3, are detail views of the mechanism for graduating the feed while the machine is in motion. Figs. 16 to 19, inclusive, Sheet 4, are detail views of the mechanism for automatically measuring the thread according to the thickness of the work and the variation in position of the presser-foot with relation to the work-plate. Figs. 20 to 23, inclusive, Sheet 4, are detail views of the shuttle, which is shown in about three-fourths size. Fig. 24, Sheet 4, is an enlarged sectional view of the top guide of the shuttle-race. Figs. 25 and 26, Sheet 5, are detail views of the awl-bar and its operative lever. Fig. 27, Sheet 5, is a sectional and top view of a flat work-plate arranged for ready application to the arch-plate.

In Figs. 1, 2, and 3 the peculiar construction of the bed-frame A is clearly illustrated. The bed-frame is cast solidly, including the end plate, a, but the race-plates a' are detachable. Between the upper ends of the race-plates is the needle-plate a^2, which, with the adjacent ends of the race-plates, constitutes an arched work-plate, convex longitudinally and laterally, and at the rear side of this work-plate there is a deep wide recess or space, A′, for the reception of depending portions of material while other portions thereof are being stitched. The arch work-plate, with the deep recess at its side, enables the execution of much work not heretofore possible, except on horn or post machines, and as arranged it constitutes a "post" well adapted for stitching long lines of narrow flexible work, or wider work, which, while being stitched, should depend from the work-plate at both sides. The work-plate being convex, as described, enables me to turn as sharp corners in heavy stitching of leather as are now possible in domestic machines on light fabrics, because, while I have a good central bearing for the work in line with the needle, the face of the work-plate gradually recedes from the under side of the work and permits a free swiveling of the latter around the awl or the needle, as the case may be, and the recess A′ permits the workman to place one hand, whenever desirable, beneath the work adjacent to the needle for easing it up while guiding it from side to side with the other hand.

In executing light flat work the ordinary flat work-plate is desirable, and I have therefore provided the plate a^3, as shown in dotted lines in Figs. 2 and 3, and in section and top view in Fig. 27, Sheet 5, wherein will be seen the usual needle-opening, and also a concavity at its under side adjacent thereto, as at a^4, for proper seating upon the crown of the arch work-plate; and it is also provided with depending lugs a^5, through which screws are passed into the tapped holes a^6 (shown in Fig. 1) in the side of the upper rear portion of the bed-frame.

I am aware that single and double thread machines for sewing hat-linings have heretofore been provided with arched work-plates, and that in chain-stitch wax-thread machines posts have been employed having bearing-surfaces more or less rounded, and also that similar posts have been employed in lock-stitch wax-thread machines, wherein the shuttle is located above the post; but so far as my knowledge extends I am the first to so organize a waxed-thread lock-stitch machine having a shuttle below the work-plate that an arch work-plate is rendered possible in that class of machines.

I am also aware that dry-thread sewing-machines have heretofore embodied eye-pointed needles, arched shuttle-races, and either straight or curved shuttles; but mine is the first machine known to me which has been devised for operating with waxed thread wherein a hook-needle, an arched race, and a curved or even a straight shuttle have been combined; and so far as I know I am the first to demonstrate the peculiar value of this novel organization for sewing with waxed thread.

The shuttle-race embodies the arch-rail B and top guides, b, which in this instance are portions of the race-plates a', which are readily detached and replaced, but are held in position by buttons at their lower ends, as shown on one side in Fig. 1. This rail and the top guides are novel in that they constitute a vertically-arched race; but otherwise they are substantially as shown in my prior Letters Patent No. 241,609, dated May 17, 1881. At intervals the top guides are provided with cushioning-bearings b', (clearly shown in Fig. 24, Sheet 4,) against which the upper sides of the shuttle bear when influenced by centrifugal force incident to high speed, which enables me

to rapidly operate a large heavy shuttle carrying a heavy load of waxed thread much more easily and smoothly than if reciprocated in a straight line. As seen in Fig. 7, one of the detachable race-plates has projecting splines, which serve as continuations of the upper guides for the shuttle beneath the needle-plate; but said splines are partially housed in said plate. The arch-rail B is preferably formed integrally upon the top edge of a segmental plate, b^2, Figs. 2 and 3, which is secured to the inner side of the end plate, *a*. This segmental plate affords centrally a vertical bearing for the bar of the hook-needle C, which is operated substantially as heretofore, with the following movements: From below it rises to its full height, descends to a point wholly below the path of the shuttle, and while the shuttle is passing it rises slightly, allowing the loop to be released from the hook, and then descends to its original position. The release of the loop is effected by the shuttle-web and its forward movement, and the loop is prevented from moving unduly forward by the surface of the shuttle-rail adjacent to the needle-path, as in my prior machines.

It is to be understood that I do not limit myself to the particular construction of rail and top guides now shown by me in the formation of a vertically-arched race, for either of the forms shown in my prior Letters Patent dated May 17, 1881, Nos. 241,608, 241,610, 241,611, 241,612, and 241,613, as well as that shown in my earlier Letters Patent No. 231,954, September 7, 1880, and many others, may be employed on the vertical-arch principle with more or less desirable results. As seen in Figs. 4 and 5, Sheet 2, the channel or groove between the top guides varies in its width at different portions of this race, for purposes hereinafter to be explained in connection with the shuttle and its operation. The arch-race also serves as two heating-flues, to be hereinafter more fully described.

The shuttle D is not shown in Fig. 2, but is clearly illustrated in Figs. 3, 4, 5, and 6; also in Figs. 20 to 23, inclusive. It has a lance-shaped point centrally located, and a longitudinal recess on its under side, substantially like the shuttle shown in my prior Letters Patent No. 231,954, but differs therefrom and from all other wax-thread shuttles of which I have knowledge in that my present shuttle is curved longitudinally in the plane of its lance-shaped point, so as to be in substance the segment of a tubular ring, and conforms to the curved line of the arch-rail B. It has also a longitudinal recess, *c*, on its upper side, within which, near the point of the shuttle, is the aperture c' for the outward passage of the thread, and cross-bar c^2, and also a flat spring, c^3, the free-end of which bears against the thread and forces it against one side of the recess. Said spring is rendered adjustable as to pressure by means of a lateral screw, c^7, as shown in Figs. 20 and 22. The portion of the recess *c* extending from the bar or pin c^2 to the heel of the shuttle receives the thread after the shuttle has passed through a loop and during the tightening of the stitch; but during its backward movement the slack thread is housed in said recess in front of the pin c^2, it being properly guided so as to thus house itself by the narrow portion of the groove or channel between the top guides of the race, as illustrated in Fig. 5, said narrow portion extending for a short distance from a point directly in the rear of the needle, or toward the left hand, as seen in Fig. 3.

At the heel of the shuttle I provide a non-resonant pad, c^4, to deaden the sound and ease the forcible contact of the driver with the shuttle when run at high speed. This pad may be made of soft tough metal—like copper, for instance—although I prefer to use rawhide. At each side of the shuttle is a longitudinal clearance-web, c^5, projecting laterally a short distance, in order to limit the area of contact of the loop with the shuttle, as illustrated in dotted lines in Fig. 23. The rear end of the shuttle, on which the pad c^4 is located, is readily removable for the insertion of the cop c^6, and is provided with a securing latch and pin. (Not shown.) The ease with which a shuttle can be thrown in a vertical-arch race enables me to make it of unusual length, and without its being unduly large in sectional area, to provide for the reception of a greater quantity of thread than any prior wax-thread shuttle of which I have knowledge—as, for instance, I work at high speed a shuttle of this character, which, as before herein stated, receives a cop containing upward of fifty yards of four-cord No. 16 thread, and a proportionally greater quantity of smaller sizes.

I find it desirable for securing smooth and easy action of the shuttle to deliver thread therefrom from an aperture at or near its nose and on its upper side, as shown, instead of delivering it from or near the heel, as generally heretofore in machines having straight shuttles. The delivery of the thread from the nose of the shuttle instead of from the heel enables me to apply the cushion-pad at the heel, and also to better control the shuttle-thread during the operation of the take-up and during the flight of the shuttle.

The shuttle-driver E is triangular in its outline, and in no manner supports the shuttle, which latter feature is found in shuttle-drivers shown in my prior patents; but, unlike them, this driver requires no slide for controlling its movement with reference to the shuttle and race, and it is therefore frictionless in its operation, save at its rock-shaft d^6, on which it is mounted, as clearly shown in Figs. 2 and 3. The front arm of the carrier, as seen in Fig. 6, has a head, d', which is bifurcated, so as to properly engage with the nose of the shuttle, and the rear arm, d^2, is provided with a convex knob, preferably adjustable, for contact with the pad c^4 at the heel of the shuttle. The driver is vibrated by a cam, E′, operating

through rock-shaft *d*, provided with an arm, d^3, and a pin occupying a cam-groove, lever d^4, and link d^5, connecting with an arm projecting from the rear arm of the carrier. After the shuttle has been fully forced through the loop the driver retires slightly, because of the shape of its cam, to permit the loop to be freely drawn upward, and then moves forward, forcing the shuttle to contribute to the tightening of the stitch, because of the heavy draft on the shuttle-thread.

The hook-needle is operated, as before herein described, by cam C′, acting through the arm partially shown at the right of the cam, the rock-shaft shown endwise at the lower left-hand corner of Fig. 3, the arm thereon, and the link connecting said arm with the base of the needle-bar, all clearly shown.

The awl-bar F is reciprocated and serves as a portion of the feeding mechanism, (in those respects,) substantially as heretofore, and is operated by the cam F′, acting through the link *e*, Fig. 2, a sleeve rock-shaft, e^4, and arm e', Figs. 25 and 26; but the flexible connection between arm e' and the awl-bar is novel in this combination. Instead of using a crank or arm and a link, as is common, I have circularly recessed the awl-bar, and fitted thereto a bearing-disk, e^2, which is slotted diametrically for the reception of the vibrating end of the arm e', said disk being held in place in its recess by the cap-plate e^3 and screws which occupy tapped holes in the side of the awl-bar. With this construction the awl-bar is vertically reciprocated smoothly and with ease, and during the reciprocation of the feed-slide the awl-bar is readily varied in its position longitudinally upon the arm or lever e'.

The cam F′ is so formed that during the movement of the feed-slide the awl is constantly rising, in order to contribute by its lifting action to an easy forward movement of the work upon the work-plate.

The feeding-slide G is reciprocated to and fro by a cam-groove in the inner face of the drive-wheel G′, acting through the link *f*, rock-shaft f' within sleeve e^4, and slotted arm f^2 on the outer end of said rock-shaft, substantially as heretofore; but I have devised means whereby the feed may be readily varied while the machine is in motion, and have also provided for its ready graduation to a predetermined scale.

I have also improved upon the construction of the parts pertaining to the feeding operation.

In my prior machine, as shown in Letters Patent No. 231,954, I provided for an adjustment of the feed-slide for varying the length of stitch by means of a slotted arm on a rock-shaft and a sliding block which coupled said arm to the slide, vertically slotted to receive one portion of said block, and the latter was made adjustable in said slide-slot by means of a clamp screw or nut having a finger-lever projecting therefrom. While thoroughly effective for the purpose intended, it could not be changed while the machine was in motion, and could only be manipulated slowly, even by an expert; but as now devised and constructed any person of ordinary skill and capable of properly guiding the work may readily change the feed to any desired degree without stopping the machine, which is a feature of great practical importance in various ways, but especially obvious, for instance, in stitching across previously-formed seams, in which case the old seam may be spanned by one or more long stitches, and yet these latter can be immediately preceded and succeeded by shorter stitches of a uniform character. In my former machine the feed-slide slot was vertical, and therefore the feeding motion was always performed on one side of the center of the rock-shaft; but now I have provided an inclined block-slot for the feed-slide, so that in the feeding motion the block has less vertical movement in the slide, resulting in much smoother action and with less friction than before, and requiring a less movement of the block to provide for a given change in the length of stitch.

The details of this portion of my invention are clearly shown in Figs. 13 to 15, inclusive, Sheet 3. In Fig. 13 the usual stationary head-plate, *g*, is broken away at the left-hand side to disclose the feed-slide G at the rear thereof. Upon this stationary plate is the feed-graduating lever g', fulcrumed at g^2, and provided with a thumb-latch, g^3, having a pin for entering any desired hole in the graduated scale-bar g^4. These holes are so located with reference to each other that, for instance, when the graduating-lever is set at the lowest hole a maximum number of stitches to the inch will be produced, and this number may be decreased in whole stitches or in fractions of a stitch by locating the outer end of the lever in some higher position. The graduations having been accurately predetermined, each hole may be respectively marked to indicate the dimensions of stitch resulting. The graduating-lever g' is connected by the link f^3 to and supports the coupled block f^4, which occupies the inclined slot g^5 in the feed-slide, its fellow block, f^5, occupying the groove or slot f^6 in the slotted arm f^2 on rock-shaft f', before referred to. These blocks, connected as described, constitute the coupling mechanism by which the slide and its vibrating mechanism are connected. Heretofore the block-slot in the feed-slide has been vertical, and the block which occupied the slot in the crank or arm of the rock-shaft was provided with a pin, which projected through the vertical slot in the feed-slide, and was locked to said slide by a nut having a lever, thus requiring considerable sliding movement of the block during the swinging movements of the rock-shaft arm, and causing most of the work of feeding to be performed on one side of the center of the rock-shaft, as hereinbefore partially set forth. As now constructed by me the two blocks are rotatively pivoted to each

other by the screw-stud f^7, so that the block f^5 may freely move axially to correspond with the various angular positions assumed by slot f^5 in the rock-shaft arm f^2, all as clearly indicated in Figs. 13, 14, and 15. The inclination of the slot g^5, as shown, is an important improvement as compared to the prior straight slot, for with this inclined slot a much less movement of the blocks is requisite for attaining desired variations, and the feeding mechanism is more easily and smoothly operated than with the straight slot in the feed-slide.

It is obvious that the coupling mechanism may be varied in its construction—as, for instance, closely resembling a "link-motion" in valve-gear of locomotives—and therefore I do not limit myself to the coupled blocks, except as indicated by my claims, although the coupled blocks are deemed preferable by me. It is also obvious that the advantages due to the inclined slot g^5 would be at least in part available, even if the matter of its adjustment were possible only while the machine was at rest.

In stitching across junctions with other seams it is frequently desirable that the stitches should be lengthened, so as not to unduly cut or tear the leather with the awl or needle adjacent to such seams; and, as will be seen, I am enabled to accomplish this end, even at high speed, without in any manner otherwise affecting the operation of the machine. It having been predetermined what length of stitch is best for crossing a prior seam, a stop-pin can be placed in the proper holes of the scale, so that the workman will have only to carry the graduating-lever against said pin, and then, when the seam is passed, replace it in its former position, and in view of the rapidity required for assuring accuracy, a second detachable stop-pin may be used, so that the range of movement possible by the lever between the two will provide for the maximum and minimum length of stitch required in each case.

It is also obvious that whether an awl or a needle be relied upon as an element in the feeding mechanism, my improvements are equally applicable, no changes being requisite, save in such variations in mechanical arrangement as might be necessarily involved, according to whether the needle operated from above or below the work-plate, or to other peculiarities common to each particular class of machines. The latch arrangement on the graduating-lever may also be varied—as, for instance, the outer end of said lever may serve as a pointer traversing the face of a marked graduating-scale, and a swiveled quick-screw tapped to a block swiveled to said lever, relied upon for effecting the adjustments, and also locking or maintaining the coupling-blocks in any required position.

I am well aware that it is not new to provide in ordinary sewing-machines for variable vibrations of a serrated feed-bar by means of levers, set-screws, and a graduated scale; but so far as my knowledge extends I am the first to devise, in combination with a slide carrying an awl or a needle for feeding, a lever for supporting and controlling coupling-blocks, whereby accurately-measured variations in the movements of the feed-slide can be promptly effected, whether the machine be in active operation or at rest.

I will next describe the mechanism which controls the upper thread and delivers it to the hook-needle. The spool (not shown) is mounted, as usual, on a vertical spindle, and the thread passes from thence through the wax-cup, (shown in dotted lines in Fig. 1,) and thence to and over a tension-wheel, h, substantially as in my first machine. The thread-wheel i is operated, substantially as before, by a rock-shaft, levers, and links, actuated by the cam in the side of the drive-wheel G′, and these, with the brake-wheel i' and shielded pulley i^2, constitute the take-up, substantially as heretofore. I also now employ a cushioned abutment, which limits the downward stroke of the thread-wheel, as in my prior machine; but instead of having the thread-wheel levers outside, as before, I now house them within the frame, and provide an abutment on the upper end of a screw, i^3, which is tapped upward through the frame, as shown in Fig. 1. From the shielded pulley i^2 in my former machine the thread passed downward through a vertical tube; but when the take-up operated, the line of draft on the thread from the stitch to the periphery of the shielded pulley was not sufficiently direct to obviate contact of the thread with the lower end of the tube. I have now provided an inclined tube, k, which is in line with the path of the needle, and substantially in line with the point at which the stitch is formed, so that when the take-up operates, the thread on being tightened occupies a straight direct line from the stitch-hole to the periphery of the pulley. In attaining this result the inclination of the thread-tube is important, because it enables me to set my thread-pulley somewhat back of the front of the head, and obtain a direct line to the stitch-line without interference with any of the mechanism contained within the head. This thread-tube will be hereinafter again referred to in connection with the subject of "heating."

For delivering the thread to the hook-needle C, I employ a vibrating thread-eye and a vibrating thread-arm; but these devices, broadly considered, are not new, as instanced by my prior Patent No. 231,954. As now organized by me, however, they involve important differences in construction and arrangement, and also in their method of co-operation with each other and with the needle, from which accrue certain advantageous results, as will be hereinafter indicated.

The thread-eye l and thread-arm m and their immediate operating mechanism are well illustrated in Figs. 8 to 12, Sheet 3, when they are so arranged that the thread drawn down for forming a loop is not variably measured auto-

matically according to the thickness of the work on the work-plate; but such variation is provided for in the organization illustrated in Figs. 16 to 19, inclusive, on Sheet 4.

As shown in Figs. 8 and 9, the thread-eye l is horizontally mounted from the lower end of a vertical branch of lever l', which is crank-shaped, and has at the end of its horizontal branch a vertical pin or stud, l^2, pivotally connected to the sliding block l^3, which is actuated through rod l^4 by the cam l^5, Fig. 2, and suitable intermediate mechanism, which in this instance embraces a bell-crank lever and a pendent link, as clearly shown in Fig. 2. The sliding block of itself would impart movement to the thread-eye in a straight line only; but the curved-line path requisite for the eye in enabling it to pass partially around the needle for delivering the thread to the hook thereof is obtained by the irregular cam-slot in the stationary plate l^6, said slot being so formed as to cause the eye to traverse the desired path, said slot being occupied by the vertical branch of the crank-lever l', as clearly shown in Figs. 8 and 9. As will be readily indicated by the form of the cam-slot in plate l^6, the eye is moved in a straight line (inclined to the path of sliding block l^3) to a point abreast of the needle, thence in a curved line partially around the needle, and then partially back again while the needle is descending, and resting so as not to deflect the standing thread during the operation of the take-up.

The thread-arm m has simply a movement in the arc of a circle, and therefore it is mounted in the lower end of a vertical rotative spindle, m', having at its upper end a horizontal lever, m^2, which at its outer end is pivoted to a reciprocating rod, m^3, which is actuated at its opposite end through a bell-crank lever and pendent link operatively connected with the cam m^4, Fig. 2.

The thread eye and arm and their respective operative mechanism are so organized that their movements result in the delivery and control of the thread, as follows: A stitch having just been completed, the thread-eye passes from the line of the standing thread (occupied during the operation of the take-up) to the rear and within the sweep of the thread-arm m, which then stands toward the needle, as indicated in Fig. 10. The thread-arm then swings around closely beneath the eye and engages laterally with the thread occupying position indicated in Fig. 11, and then, after the arm has swung rearwardly merely for the purpose of securely retaining the thread delivered to it by the eye, which then moves forward around the needle, pulling down thread and delivering it to the needle in a horizontal bight at a point between the arm and eye, as clearly seen in Figs. 8 and 9, whereupon the needle descends, the thread-eye retires to a point in line with the axis of the inclined thread-tube, the thread-arm meantime swinging to the front for dropping or releasing the thread to the needle in position as indicated in Fig. 12. In operation these devices differ from prior combinations of thread-eye and thread-arm in that the thread does not slip or drag over the arm, and the thread is gradually freed therefrom bodily as the needle descends, and the eye does all the service of drawing down sufficient thread while the take-up is elevated, and the thread is therefore perfectly free to be readily drawn down without undue abrasion by the thread-eye.

In my prior machine the thread-arm traversed the line of the standing thread in a right line, and therefore was provided with a latch-tip, so that it could yield in passing by the thread prior to engagement therewith, and although in my Letters Patent No. 231,954 I suggested the movement of that arm in the arc of a circle, said arm in that organization would nevertheless be necessarily provided with the latch-tip, because the standing thread would all the same occupy a position within the circle to be partially traveled by said arm. My present arm has no latch and needs none, for it relies upon the thread-eye to deliver thread to it instead of helping itself to the standing thread, as before. In drawing down the thread in my prior machine the arm and eye, both being engaged with the thread, moved simultaneously from each other, and therefore the thread was dragged through the eye and also over the arm; but now, as before stated, it is drawn through the eye only, and when a sufficient quantity of thread is thus provided it is absolutely free for its downward course with the needle. This combination of a thread-eye which delivers thread to an arm which only moves for the purpose of securely holding the thread thus delivered to it by the eye, said eye then proceeding to deliver thread to the needle, is a novel feature, and valuable because of the non-abrasion of the thread by the arm, and it is also novel to combine these elements, as described, so that the arm is always not only at one side of the needle, but also at one side of the presser-foot and never above it, for reasons as follows, viz:

When an arm is used which does not occupy at any time any space above the presser-foot thicker work can be sewed with a needle of a given length, because no obstacle is presented to the complete elevation of the presser-foot except the eye, which obviously must traverse the path of the needle above the presser-foot. Again, greater certainty of operation is attained with an arm to which the thread is delivered by the eye as compared with a latch-arm which proceeds to the standing thread and engages therewith, because fine hard-twisted thread is liable to erratic vibrations, during which the latch-arm may or may not get a proper hold thereon, whereas with my present arm no vibration of the thread can possibly occur adjacent to the eye, at which point the delivery of thread to the arm occurs.

It is not new to employ a swinging thread-arm with a swinging eye, but, as heretofore organized and operated, the arm helped itself

to thread during the movement of the eye, and by continuing onward said arm carried the thread in a direction away from the eye and over the presser-foot, so that the thread slipped over the arm; and it is the abrasion incident to this slipping action at the arm which I have obviated by having the eye carry the thread to the arm, which merely holds it while the eye next proceeds to and around the needle; and instead of delivering the thread to the needle in a straight line between eye and arm, as heretofore, the thread is delivered to the hook in a horizontal bight, as clearly shown in Fig. 9, thereby greatly contributing to an unfailing and accurate engagement of the thread by the hook. In said prior organizations of swinging thread eye and arm the latter swung over the presser-foot; and in order that the latter could nevertheless be lifted, said foot, eye, and arm were connected together, so that all were raised or lowered together, involving a complication in the operative mechanism of the eye and arm, which I obviate by locating my arm wholly at one side of the presser-foot.

It will be readily understood that according to the extent of the rearward vibration of the thread-arm the quantity of thread measured off by the arm and eye for delivery to the needle will be varied; and, as thus far described, it will be seen that no provision has been referred to for varying this measurement of thread to substantially correspond with the thickness of work to be stitched.

In my aforesaid prior Letters Patent No. 231,954 I described means for automatically varying the measurement of thread to the needle, proportioned to the elevation of the presser-foot above the work-plate, or, in other words, the thickness of the materials to be stitched. In my prior machine the extent of movement by the thread-eye was varied; but it is obvious that either the arm or the eye, or both of them, may be thus variably moved for attaining the variable delivery of thread to the needle.

In my present machine I provide for variation in the position of the thread-arm, and the particular means employed therefor are with slight modification applicable for variably moving the thread-eye. The thread-arm as now used by me has a thread-seat near its outer end, which will enable it to maintain a good control over the thread, even if it should be swung almost fully rearward, so that variation to some extent could be provided for by swinging the arm from, say, ninety degrees to nearly one hundred and eighty; but I prefer that the swinging movement be uniform, and that the arm be bodily changed in position for attaining the variable measurement of the thread. The novel mechanism for attaining this end is illustrated in detail in Figs. 16 to 19, inclusive, Sheet 4. The thread-arm *m* in this case is vibrated on its axis *n*, which, instead of occupying a fixed position, is rendered movable by being mounted at the outer end of a pivoted lever, n', having a stationary axis, n^2, and an inclined lug or web, n^3, on one side of said lever, which is held by means of a spring (clearly shown) in constant engagement with the edge of a lug, n^4, projecting from the coincident side of the presser-foot bar *o*. The lug or web n^3 inclines outwardly from bottom to top thereof, and therefore, when the presser-foot is at its lowest position on thin work, the axis *n* of the arm *m* occupies the nearest possible position to the needle, or to the outermost limit of the path of the thread-eye; but as the presser-foot is raised said axis *n* is thrown rearward, thus causing the thread-arm to hold the thread proportionably farther to the rear and nearer the rear end of the path traversed by the thread-eye. The presser-foot is shown at its lowest position in Figs. 16 and 17, and in Figs. 18 and 19 at its highest, and with the thread-arm in each case correspondingly varied in its location. The movement of the thread-eye is uniform, and its path is always sufficiently extended rearward to enable the arm to engage with the thread, wherever said arm may be located.

The previously-described reciprocating rod m^3 is here employed, which, as before described, is reciprocated by the same cam, m^4, and the bell-crank lever. The circular or swinging movement of the thread-arm, on account of its variable axis, requires a more complex connection of said arm with the reciprocating rod m^3, which, instead of being directly pivoted to the lever in which the arm is mounted, as before described, is pivoted to the long arm of the bell-crank lever n^5, the short arm of which is connected by a link, n^6, with the projecting rear end of the thread-arm itself, so that as the rod m^3 is reciprocated the arm will be properly swung on its axis regardless of the position the latter may occupy. The thread arm and eye constructed and co-operating as organized by me are so positive and reliable in their delivery of thread to the hook of the needle, and in gradually giving off the thread by the arm as the needle descends, that I am enabled to rely upon a very small hook, and a smaller-sized needle and awl may therefore be used with thread of a given size or number than in my prior machine.

The eye and arm, if not variable in action, as described, always provide ample thread for the passage of the shuttle, and the variable arrangement operates in like manner, but in addition thereto also provides for more or less thread, according to the thickness of the work. As a result of the feature last named I am with this machine, as with my prior machine, enabled to fill the awl-hole tightly with thread without chafing the thread or disturbing the wax, and especially so far as relates to the stripping action by the hook needle incident to machines wherein no variable measurement of thread has been duly provided for.

The presser-foot *o*, as heretofore, is depressed by a spring, and lifted during the movement of the feed-slide by means of the lever o' and

cam o^2, Fig. 2. In my former machine a similar combination of devices was employed; but I have now improved the same so far as to locate the lever within the frame of the machine, and also to provide for a more convenient and desirable variable lift of the presser-foot than in my former machine. The outer end of lever o' is provided with a vertical adjusting-screw, o^3, the top of which engages with the under side of the lifting-finger o^4 on the presser-foot bar, and affords an adjustable seat, so that on raising or lowering the screw the degree of lift may be varied. I have also provided, as heretofore, for lifting the presser-foot by means of a treadle, o^5, which, by a suitable link, cord, or wire, is connected with the rear end of the separate lifting-lever o^6, so that when the machine is in operation the workman may employ both hands at the work-plate and control the presser-foot with his foot. It will be understood that the lifting-finger o^4 and its spring-clamp are as described in my prior Letters Patent No. 231,954.

In heating my machine I have, as I believe, devised certain novel features of practical value, some of which are applicable to wax-thread machines as heretofore organized.

I have already described the arched shuttle-race and referred to its value in connection with heating. It will be seen that each side portion of the race may be utilized as a heating-flue. The race-plates a' are occasionally perforated near the upper portions thereof to afford a vent for the heated air, which also partially ascends vertically through the hole in the needle-plate in favorable contact with the standing thread.

Two gas-jets, p, are employed by me, (although one may sometimes be relied upon,) and the heat from both ascends upwardly and merges at the central upper portion of the race, which serves as two heating-flues, within which the shuttle is continuously moving to and fro, so that it is exposed to heating-currents applied longitudinally thereto, and in a manner most favorable to a proper degree of heat without liability of an injurious excess thereof. This combination of an arched race with one or more heaters located at the lower ends thereof I deem of great practical value for the purposes intended.

In my prior machine and in others of the same general class thread-tubes have been employed in connection with burners which directly heated the tubes. The overheating of said tubes is therefore quite frequent, resulting either in damage to the thread or such a burning of the wax as to render it unsuitable to effect the purposes desired. I have obviated this liability of overheating thread-tubes by what, as I believe, is a novel application of the well-known principle of heating by metallic conduction. The inclined thread-tube k, before herein described, is made of copper, and has at its upper end an elbow, k', the top of which is open, in line with the tube, to admit of access by the thread thereto. Inserted into the outer end of the elbow is a copper rod, k^2, which at its opposite end is bent downward, and there connected with a flat heating-plate, k^3, also of copper, (or other good heat-conducting metal,) beneath which is the burner p', so that the flame of the latter heats the plate, and through the rod and elbow heats the thread-tube. I deem this feature of heating thread-tubes by metallic conduction from a burner so remotely located as to in no manner interfere with or be disturbed by the mechanism within the head of great practical importance. With this method of heating I am also easily enabled to keep the tension and take-up mechanism well heated by attaching the bracket k^4 (which sustains the rod and heating-plate) directly to the rear of the frame-plate k^5, on which the tension-wheel h is mounted, so that heat is conducted thereto, and thence to the waxed thread in contact therewith. The thread-arm and the thread-eye may also be kept well heated by extending branches of a similar heat-conducting rod to the sleeves or bearings in which those devices are mounted.

The wax-cup is located above the heating-plate, which is slotted or perforated, and may be mounted, if desired, upon a vertical branch of the conducting-rod, and, because of the provisions made for heating the thread in transit, the wax in the cup need never be exposed to such heat as would be liable to injure the wax.

In the best arrangement known to me the several burners are connected with gas-pipes within the frame, as at p^2, each branch thereof being provided with cocks, as at p^3, for separately graduating the burners.

The operation of the machine as a whole will be readily understood in view of the fact that I have fully set forth in each case the operation of the several parts in connection with the detailed description thereof.

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

1. The combination of a hook-needle, thread delivering and controlling mechanism, a curved shuttle, and an arched shuttle-race, serving as a heating-flue, substantially as described.

2. The combination of a hook-needle, thread delivering and controlling mechanism, a curved shuttle, an arched shuttle-race, and an arched work-plate, said needle, shuttle, and race being beneath the work-plate, substantially as described.

3. The combination of the hook-needle, the work-plate convex laterally and longitudinally, and the shuttle beneath the work-plate operating in a race which serves as a heating-flue, substantially as described.

4. The combination of a hook-needle, a curved centrally-pointed shuttle, an arched shuttle-race which supports the shuttle in its course therein and serves as a heating-flue, and a shuttle-driver mounted on a rock-shaft below the center of the race, substantially as described.

5. The combination, with a shuttle having a longitudinally-recessed web or groove on its upper side, of a race-plate grooved on its under side for co-operating with the shuttle for causing the slack shuttle-thread to occupy the recess in the top of the shuttle during its backward movement, substantially as described.

6. In an arched or curved shuttle-race serving as a heating-flue, upper bearings for the shuttle composed of cork or similar yielding material not injuriously affected by heat, substantially as described.

7. A curved shuttle provided with a longitudinal thread-recess extending from nose to heel on its upper side, substantially as described.

8. A curved shuttle provided with a longitudinal thread-recess on its upper side and a thread-delivery aperture near the nose of the shuttle, substantially as described.

9. A curved shuttle having a thread groove or recess on its upper side extending from nose to heel, and a spring for bearing upon the thread within the recess, substantially as described.

10. In a sewing-machine, a segmental plate integrally affording an arched shuttle-rail, and bearings for a needle-bar, substantially as described.

11. The combination, with the awl-bar, its operating rock-shaft, and the arm or lever thereon, of the bearing-disk on the awl-bar, slotted to receive said arm, substantially as described.

12. The combination, substantially as hereinbefore described, with the feed-slide carrying an awl or a needle for feeding its vibrating mechanism and coupling mechanism, of a feed-graduating lever for varying the position of said coupling mechanism, whether the feed-slide is in motion or at rest, and for supporting said mechanism in position, as set forth.

13. The combination, substantially as hereinbefore described, of the slide-vibrating mechanism, the feed-slide having an inclined slot, and the coupling-blocks capable of a sliding movement for varying the vibrations of the feed-slide while in active operation, as set forth.

14. The combination, substantially as hereinbefore described, of the slide-vibrating mechanism, the feed-slide having the inclined slot, the coupling-blocks, and means for fixedly adjusting said blocks, and thereby varying the vibrations of the feed-slide, as set forth.

15. The combination, substantially as hereinbefore described, of the vibrating slotted arm, the slotted feed-slide, the coupling-blocks, the lever for moving said blocks in their slots, and the graduated scale.

16. The combination, substantially as hereinbefore described, of the feed-slide carrying an awl or a needle, the feed-graduating lever, the coupling mechanism controlled by said lever, the graduated scale, and a locking device for maintaining said lever and supporting the coupling mechanism in any desired position.

17. The combination, with a hook-needle below a work-plate and take-up mechanism, including a pulley over which thread passes just prior to approaching the needle, of an inclined thread-tube which occupies a direct line from the periphery of said pulley to the path of the needle, substantially as described.

18. The combination, with a hook-needle and a presser-foot, of a thread-eye for carrying thread across the path of the needle and above the presser-foot, and a thread-arm vibrating in the arc of a circle wholly at one side of the presser-foot and the path of the needle, substantially as described, whereby the space above the presser-foot, less that required by the thread-eye, is rendered available for the complete elevation of the presser-foot.

19. The combination, substantially as hereinbefore described, of a hook-needle, a thread-arm, a thread-eye, and operating mechanism for the arm and eye, which causes said eye to first carry and deliver the thread to the arm and thence deliver thread to the needle, and also causes the arm to merely retain and release the thread delivered to it by the eye, whereby said arm is prevented from abrading the thread, as set forth.

20. The combination, substantially as hereinbefore described, of a hook-needle, take-up mechanism, a thread-tube in line with the path of the needle, and a thread-eye which, when it has delivered thread to the needle, rests in line with the thread-tube during the operation of the take-up, for obviating deflection and the consequent abrasion of the thread by the eye, as set forth.

21. The combination of the hook-needle, the thread-eye, its lever and reciprocating slide, and the stationary slotted plate, substantially as described, whereby the path traversed by the eye toward and from the needle is laid in a straight line, and in a curved line in delivering thread thereto, as set forth.

22. The combination, substantially as hereinbefore described, of a hook-needle, a presser-foot, a vibrating thread-eye, and a thread-measuring arm which is variably adjusted for measuring off thread by the vertical movement of the presser-foot.

23. The combination of the presser-foot and the thread-arm pivoted upon an axis, which is varied in its location by raising or lowering the presser-foot, substantially as described.

24. The combination, with the presser-foot provided with a rounded projection on its bar, of a thread-arm rotatively mounted on a lever, a vertically-inclined lug or web on said lever, and a spring for maintaining the surface of the inclined lug in contact with the projection on the presser-foot bar, substantially as described, whereby the position of said thread-arm is varied by the vertical adjustment of the presser-foot, as set forth.

25. The combination of the thread-arm, mounted on a movable axis, the presser-foot controlling the position of said axis, the reciprocating

rod, and the bell-crank lever and link connecting said rod with the thread-arm, substantially as described.

26. The combination, with the presser-foot, its bar, and lifting-finger, of the vibrating lever which lifts the foot during the feeding operation, and an adjustable seat for the lifting-finger on said lever, substantially as described.

27. The combination of an arched shuttle-race, a wax-thread shuttle, and one or more heating-burners located near the lower ends of the race, substantially as described, for heating the shuttle and its contents, as set forth.

28. The combination, substantially as hereinbefore described, with the parts to be heated in a wax-thread machine, of a burner or burners remotely located from said parts, and intermediate metallic connections for metallically conducting heat from said burners to said parts, as set forth.

29. The combination, with a thread-tube for heating thread in its passage through said tube, and a heating-burner remote from said tube, of a heating rod or plate connected with said tube at one end and exposed to the flame of the burner at its opposite end, substantially as described.

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