No. 607,081. Patented July 12, 1898.

F. H. RICHARDS.

SEWING MACHINE.

(Application filed Oct. 17, 1896.)

(No Model.) 4 Sheets—Sheet 1.

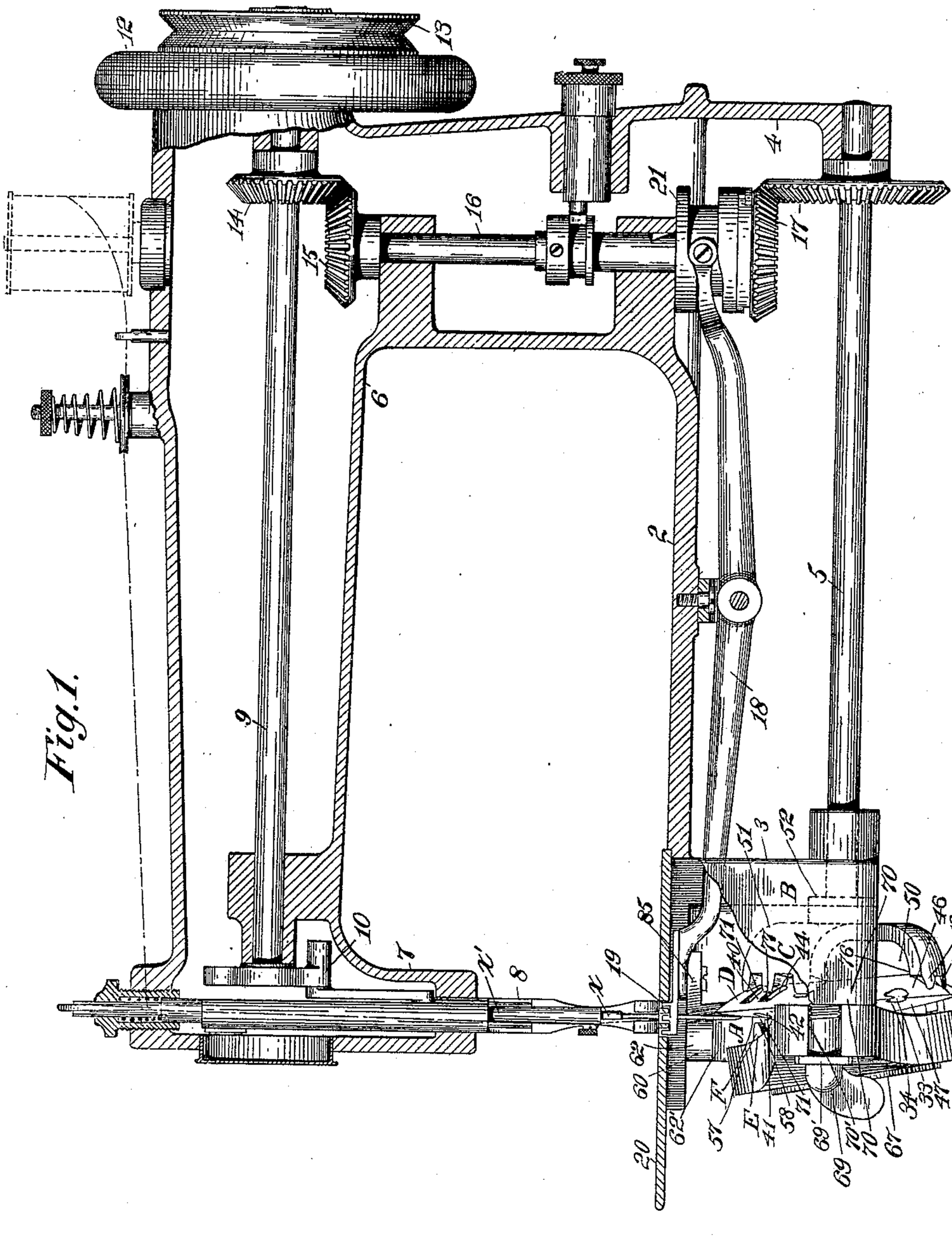

Fig. 1.

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(No Model.) 4 Sheets—Sheet 2.

Fig. 2.

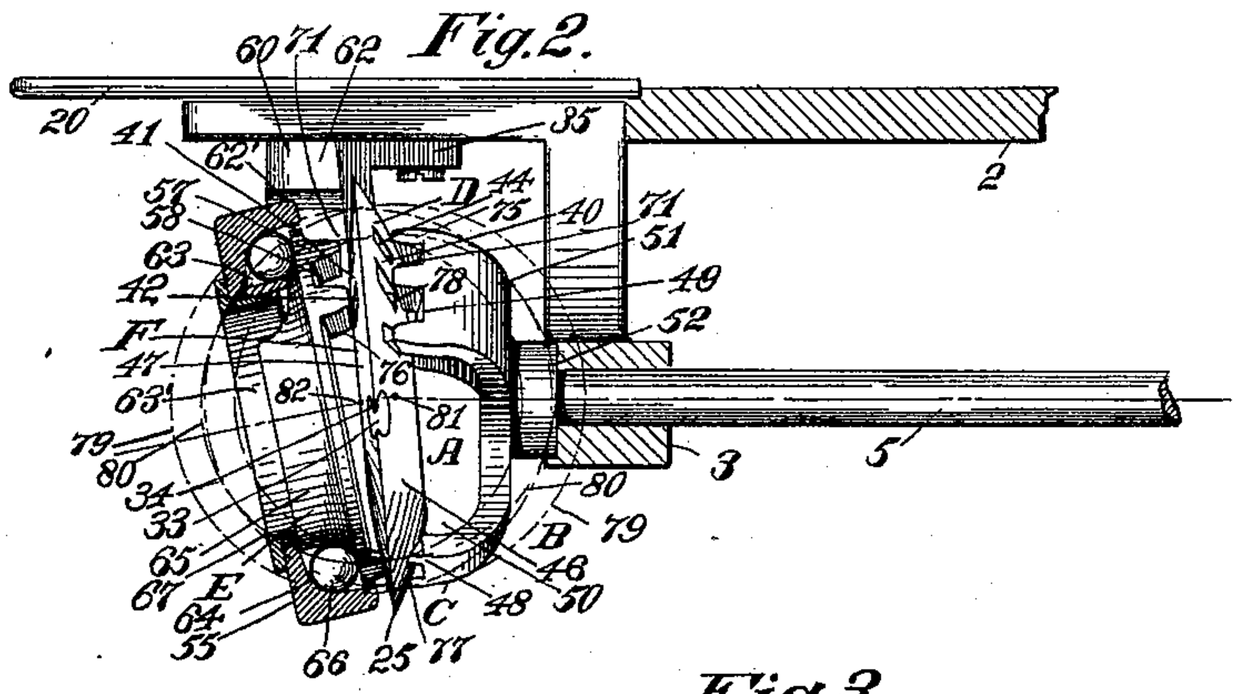


Fig. 3.

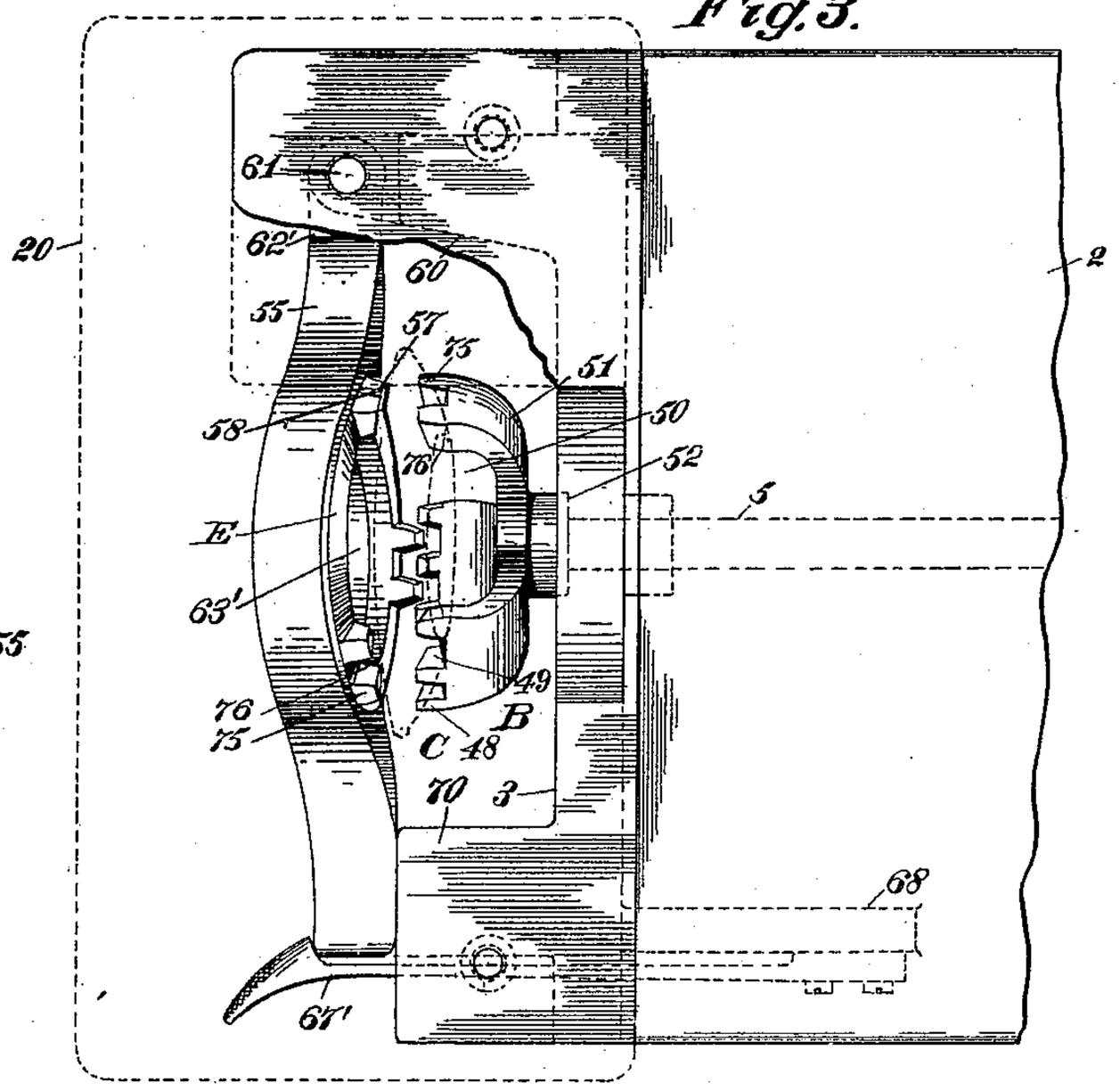


Fig. 5

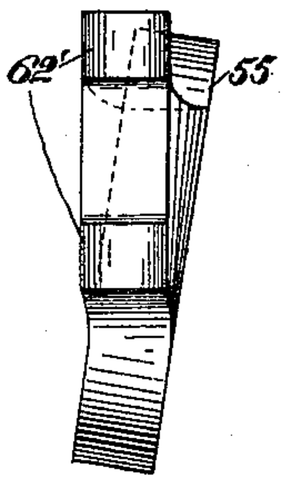


Fig. 4.

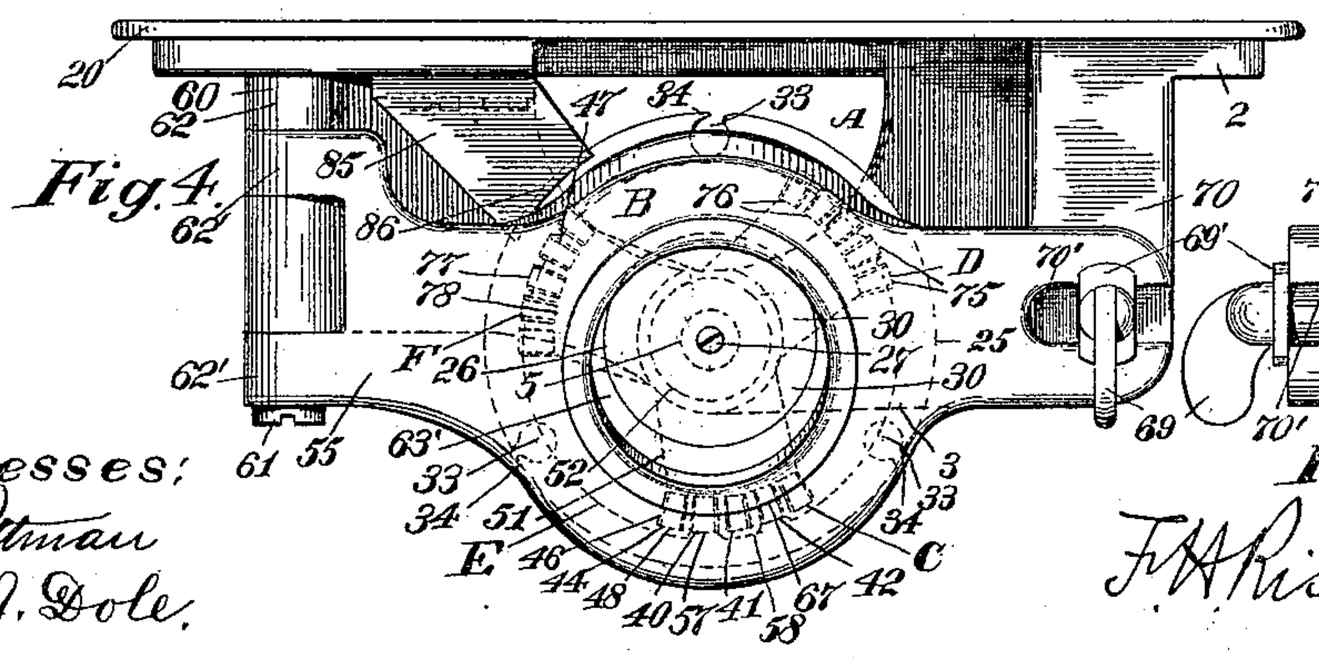
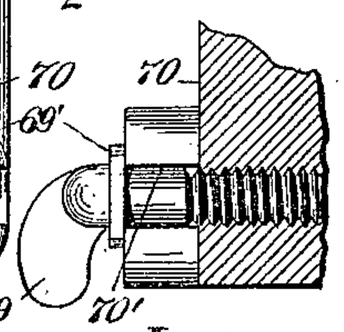


Fig 6



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(No Model.) 4 Sheets—Sheet 3.

Fig. 7.

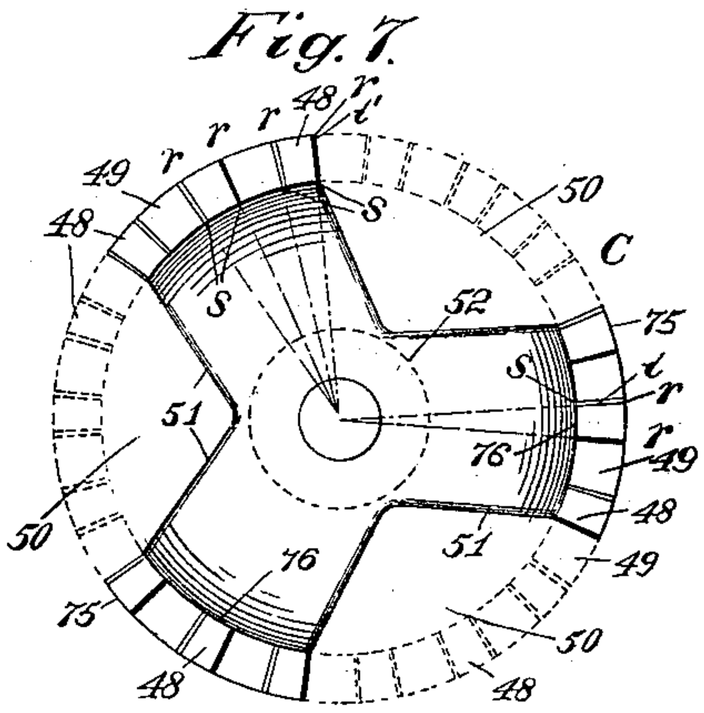


Fig. 8.

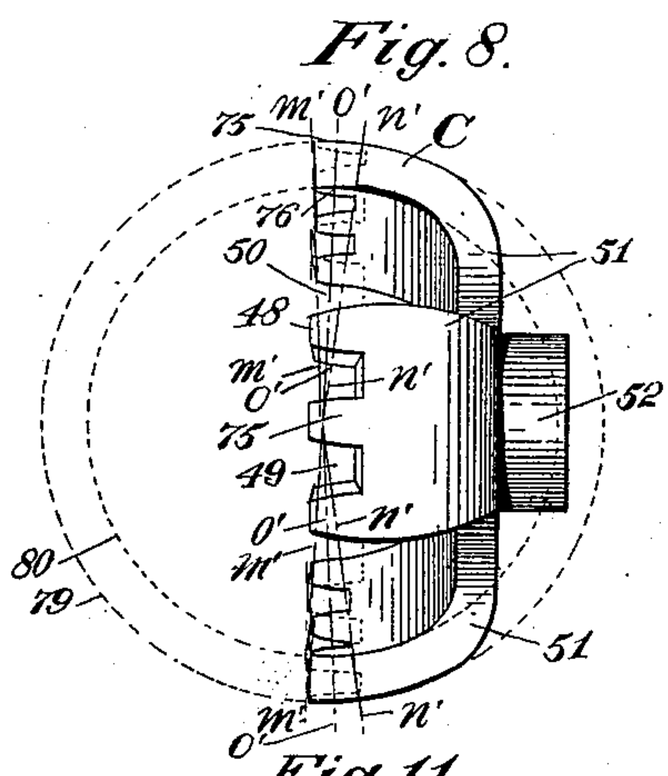


Fig. 9.

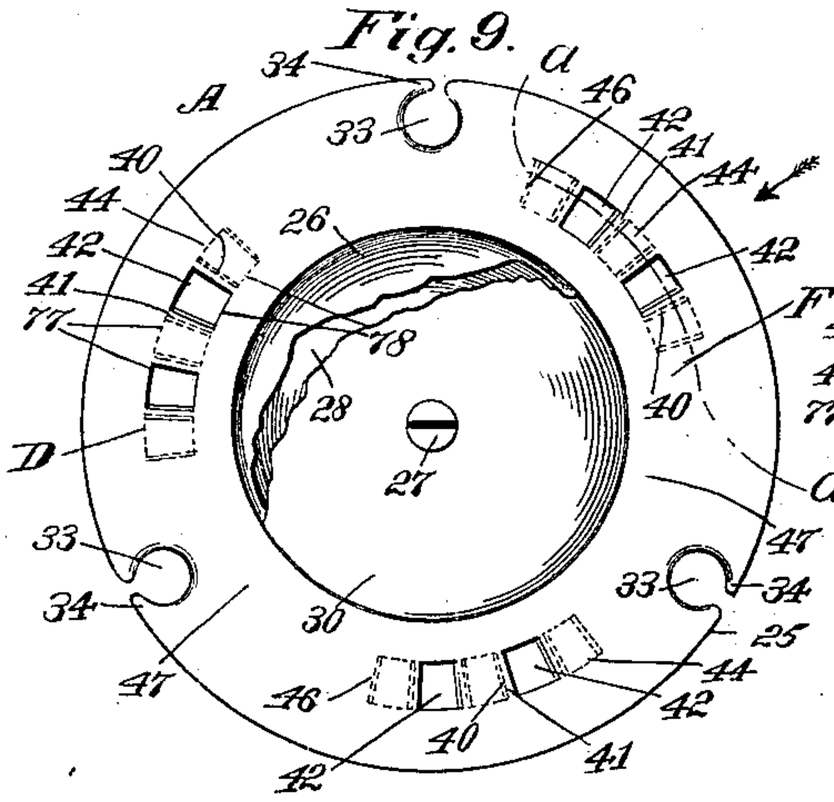


Fig. 11.

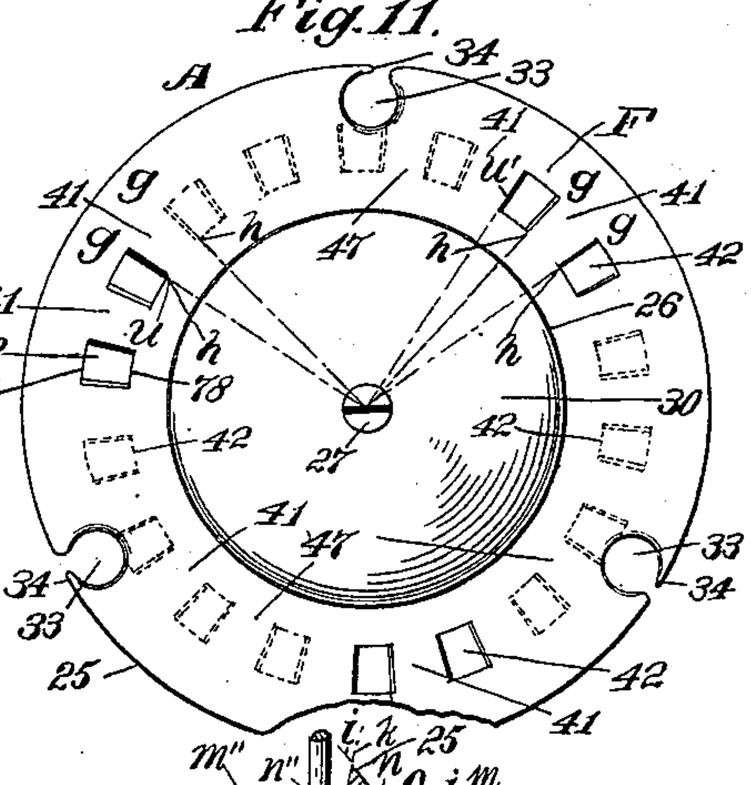


Fig. 12.

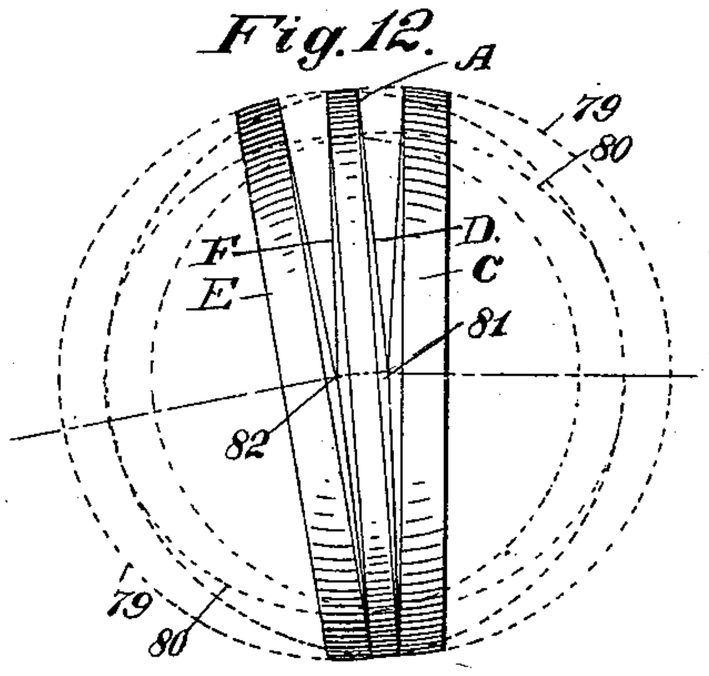


Fig. 13.

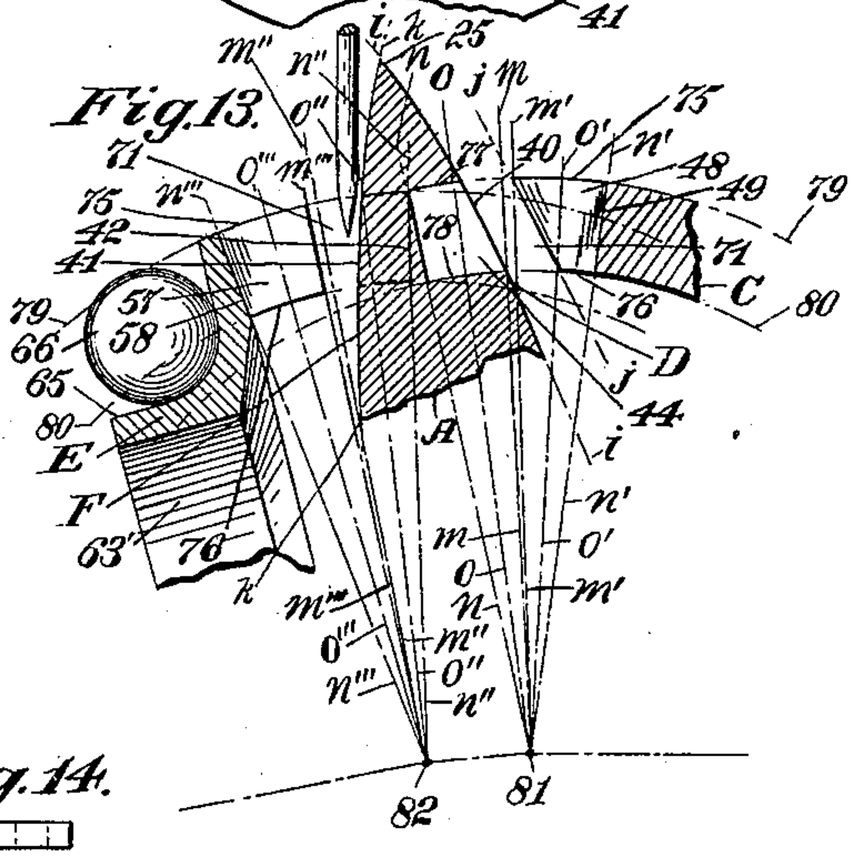
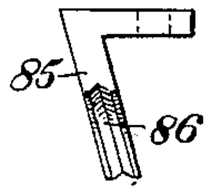


Fig. 14.



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No. 607,081. Patented July 12, 1898.

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SEWING MACHINE.

(Application filed Oct. 17, 1896.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 15.

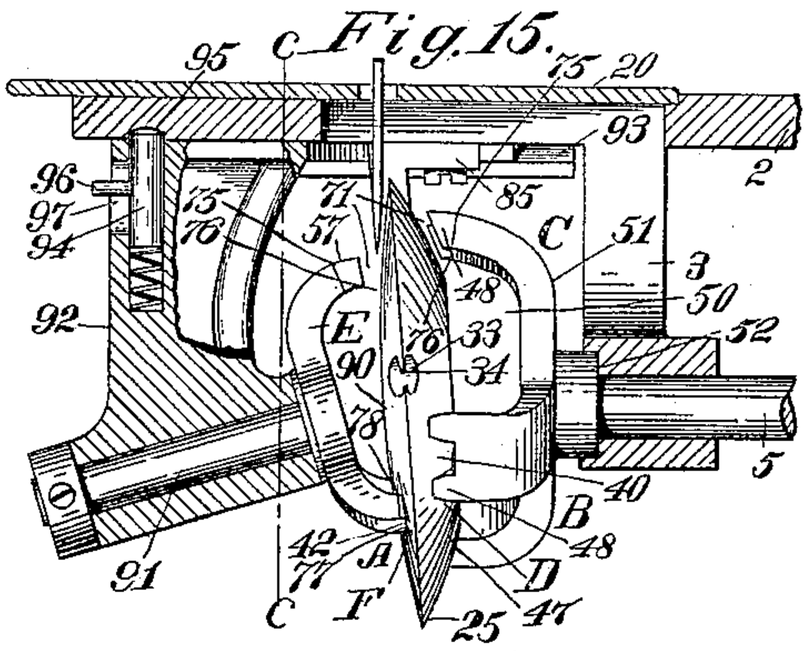


Fig. 17.

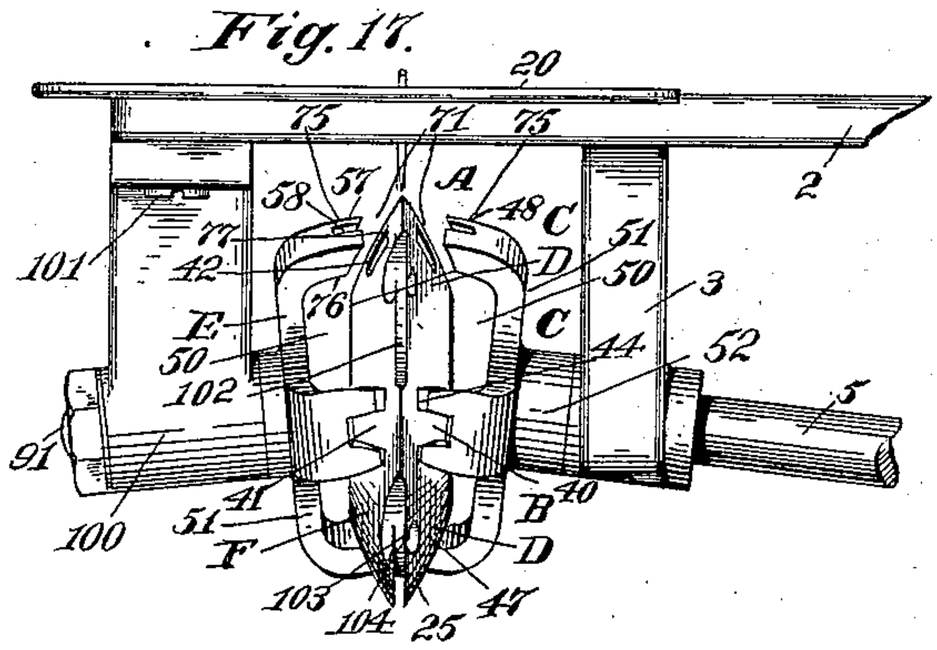


Fig. 18.

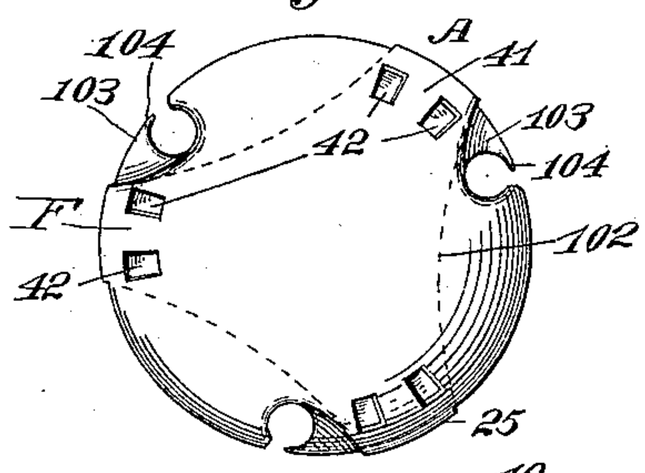


Fig. 19.

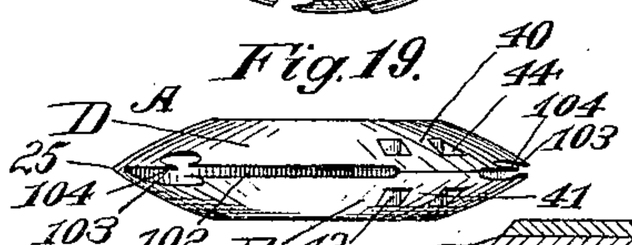


Fig. 20.

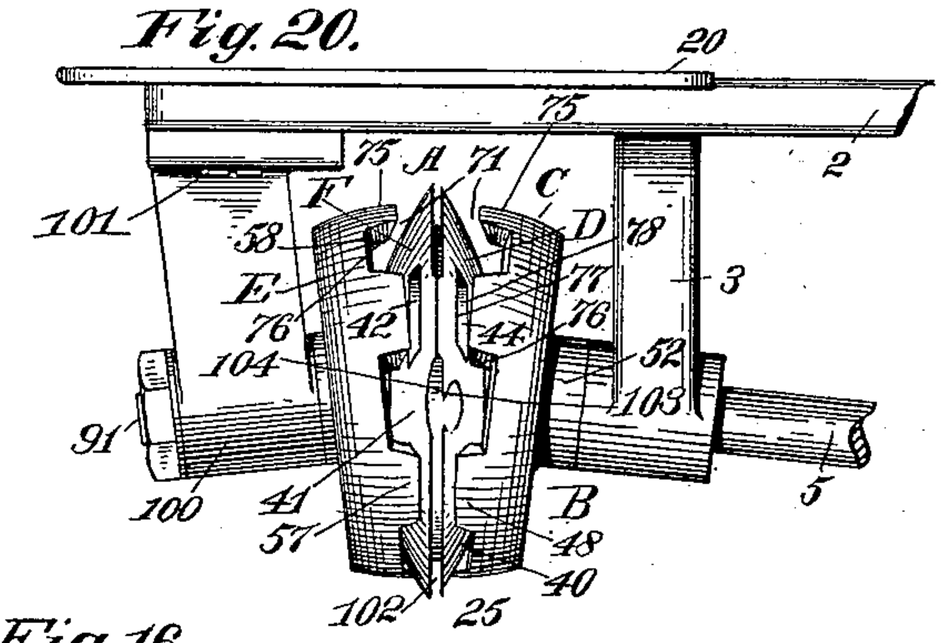


Fig. 16.

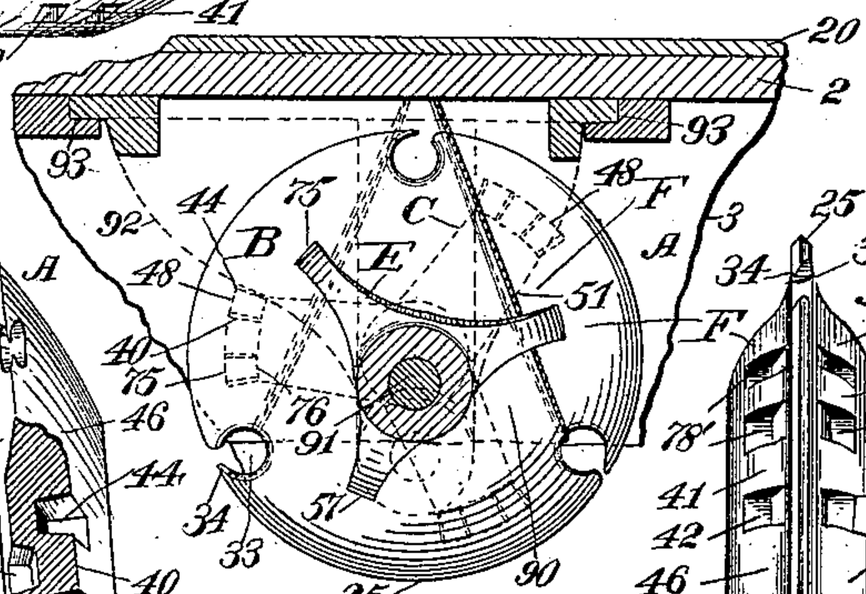


Fig. 10.

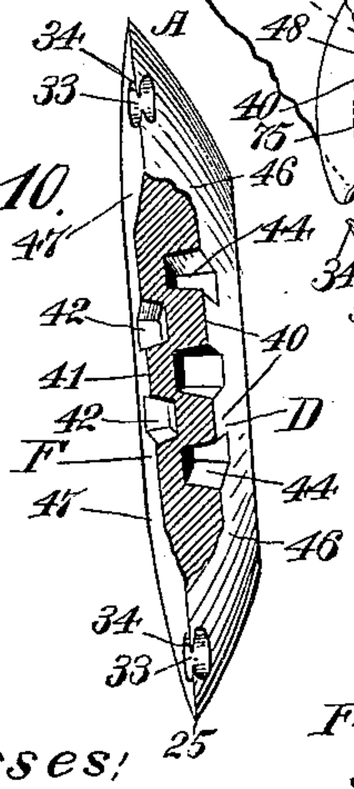


Fig. 21.

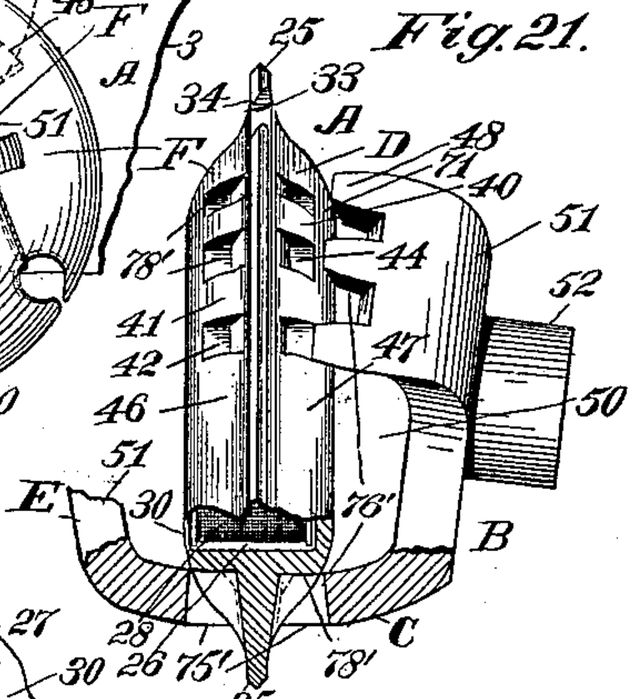
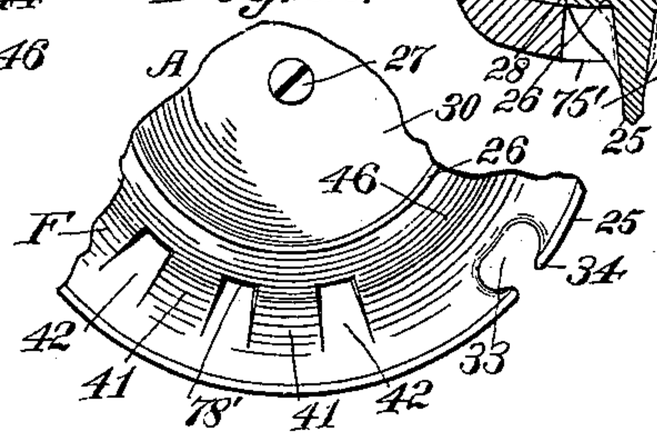


Fig. 22.



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Fred. J. Dole.

Inventor:
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UNITED STATES PATENT OFFICE.

FRANCIS H. RICHARDS, OF HARTFORD, CONNECTICUT.

SEWING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 607,081, dated July 12, 1898.

Application filed October 17, 1896. Serial No. 609,200. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS H. RICHARDS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Sewing-Machines, of which the following is a specification.

This invention relates to looper mechanisms for sewing-machines of that class in which a rotatable looper or shuttle is employed for engaging a needle-loop and carrying it entirely around the same to inclose a second or lower thread or to permit a succeeding loop to be carried therethrough to thus form a stitch, the object of the invention being to provide an improved rotatable looper mechanism comprising a looper and driving and supporting mechanism simple in its construction and the latter not only constituting actuating means for the looper, but also supporting means for the same, and thereby doing away with peripheral or other independent means of support, as in mechanisms of this character heretofore in use, and in which improved looper mechanism the coöperating parts of the looper and driving and supporting mechanism will have a bearing engagement with each other with such a high degree of precision that the tendency of such bearing parts to become dislocated or separated, as in the common construction of looper mechanisms, is positively prevented, whereby a more perfectly-operating looper mechanism is obtained than has heretofore been practicable and whereby also the looper or shuttle can be actuated at a high rate of speed and at the same time be positively maintained against radial or diametrical vibratory movement and also against lateral movement.

In the drawings accompanying and forming part of this specification, Figure 1 is a side elevation of one construction of sewing-machine, partly in section and having as a part thereof one form of this improved looper mechanism. Fig. 2 is a side elevation of one form of this looper mechanism in position below the throat-plate, a part of said mechanism being in section. Fig. 3 is a top view of this form of looper mechanism with the looper shown in dotted lines. Fig. 4 is an end view of this looper mechanism, looking toward the right in Fig. 3, said view showing, however, a different form of fastening means for the bracket from that shown in Fig. 3. Fig. 5 is an end view of the swinging bracket for the rotatable support of the looper mechanism. Fig. 6 is a detail of one form of fastening means for such swinging support. Fig. 7 is a side view of a driver as it would appear if provided with its usual complement of teeth, the opposite support being similar, except that it is provided with a less number of working teeth and in one form has an annular recess or opening for the insertion and removal of the bobbin and the non-working teeth being shown in dotted lines. Fig. 8 is a front view thereof. Fig. 9 is a view of one side of the looper or shuttle, the tooth-spaces at the opposite side thereof being shown in dotted lines. Fig. 10, Sheet 4, is a cross-sectional view of the looper, taken in line *a a*, Fig. 9, and looking in the direction of the arrow. Fig. 11 is a view of one side of the looper or shuttle as it would appear if provided with its usual complement of teeth, the opposite side of the looper being similar, except that it is provided with a larger number of working teeth and the non-working teeth being shown in dotted lines. Fig. 12 is a view representing the pitch-cones of the looper and its driver and support as they appear without teeth. Fig. 13 is a diagrammatic illustrative sectional view of the upper part of the looper mechanism for the purpose of illustrating the angle of inclination of the looper and its driver and support and the teeth thereof. Fig. 14 is a detail view of the grooved guide. Fig. 15 is a view of another form of looper mechanism, partly in section, in which the driver is shown of greater diameter than the support. Fig. 16 is a cross-sectional view thereof, taken in line *c c*, Fig. 15, and looking toward the right. Fig. 17 is a view of still another form of looper mechanism, the looper in this instance being provided with a needle-slot formed substantially in its periphery and said looper being supported in a plane parallel with the path of the needle. This view also represents both the driver and support as normally non-movably supported on the framework of the machine and both having the same number of teeth. Fig. 18 is a side view of this form of looper. Fig. 19 is an edge or plan view thereof. Fig. 20 is a view of yet

another form of looper mechanism, the driver and supporting-gears and looper in this instance being provided with a full complement of teeth. Fig. 21 is a front or edge view, partly in section, of a looper having the inner walls only of its tooth-spaces spherically shaped, the outer walls thereof being cut away, and said view also showing a portion of the driving and supporting mechanism, also partly in section; and Fig. 22 is a side view of a portion of said looper.

Similar characters designate like parts in all the figures of the drawings.

Heretofore in a looper mechanism of this class the looper or shuttle thereof has generally been supported by means of rolls disposed about the periphery thereof, said rolls serving both as guiding and supporting means, and as the looper or shuttle of this character usually has peripheral loop-receiving openings or recesses said looper during the rotation thereof has a tendency toward diametrical or radial vibratory movement when said peripheral recesses arrive contiguous or adjacent to said supporting-rolls, and thus permit a small portion of the periphery of such rolls to enter said recesses, thereby causing the jumping of the looper toward and from the rolls. Not only this, but owing to the necessity of using a construction of driver which will have a part thereof in engagement and a part thereof out of engagement with the looper simultaneously in order to permit the passage of the thread-loops around the same the coöperating or engaging parts thereof in the construction of looper mechanisms heretofore in use have a tendency to become dislocated and separated from a true bearing engagement with each other, thus permitting the jumping of the looper, as above set forth, as well as also permitting a lateral movement thereof, all of which causes are sufficient to prevent the proper taking of the needle-loops by the loop-takers of the looper and consequently the perfect operation of the machine. In order, therefore, to obviate these disadvantages, I have provided an improved looper mechanism in which the operating mechanism thereof will not only constitute means for rotating the looper, but will also constitute means for supporting the same, and thereby do away with peripheral or other independent means of support, and which operating means will have a bearing engagement with the looper with such a high degree of precision that vibratory movement of said looper in a radial or diametrical as well as in a lateral direction will be positively prevented.

This improved looper mechanism comprises, in a general way, a looper or shuttle, (designated generally by A,) which may be of any preferred construction so far as the loop-takers thereof and the manner of supporting the bobbin or cop (should one be used to form a lock chain-stitch) are concerned, and driving and supporting mechanism, (designated in a general way by B,) and which likewise may be of any desired construction, so far as the means for supporting and imparting motion thereto are concerned, and which mechanism comprises, in the preferred form of looper mechanism shown, a driver and a support, (designated in a general way by C and E, respectively,) one disposed at each side of the looper, and which driver, support, and looper in the present construction are formed as true bevel-gears adapted to coact, and thus jointly constituting means for supporting and operating the looper. The driver and support are also preferably so constructed in this form of looper mechanism that they constitute supporting or holding means for the looper, this being preferably accomplished in the present structure thereof by so forming the bevel-gear looper and its driver and support that they will have coinciding spherical engaging surfaces bearing the one upon the other at each side of the looper, whereby they will have curved bearing-faces in a plane transverse to the plane of rotation of said looper, and thus constituting, as above set forth, means for sustaining the looper in proper position against both radial or diametrical and lateral play. As a preface, however, to a more particular description of this improved looper mechanism, it will be understood that the improved supporting means for the looper (herein shown as the coinciding spherical bearing-surfaces) could be used with other driving means than that herein shown and that the bevel-gear teeth constituting the driving means herein could be used with other supporting means, and hence independently of the supporting or holding means herein shown, if desired. In other words, neither is dependent upon the other to constitute an operative looper mechanism; but it has been found in practice that the disadvantages heretofore found in this class of looper mechanisms are avoided by the coaction of the improved supporting and driving means herein shown in their preferred constructions. Furthermore, it will be understood that the different forms of looper mechanisms herein shown and described are simply preferred constructions of various looper mechanisms of similar character that might be used to accomplish the purposes above set forth without departing from the scope of this invention, the gist thereof being to provide looper mechanism in which the looper and driver or driver and support will form true beveled gears, and the said mechanism will constitute both supporting means and also driving means for the looper.

As this improved looper mechanism can be used with various kinds of sewing-machines, said mechanism is, for convenience, shown in the accompanying drawings embodied in a sewing-machine of the same general character as that described in my prior patent, No. 574,573, dated January 5, 1897, to which reference may be had for a more definite description of the construction, organization, and

operation of the various elements thereof. In part this machine comprises a bed-plate 2, having depending brackets 3 and 4 for supporting the driving-shaft 5 of the looper-driving mechanism, a machine-arm 6, having a head 7 at the outer end thereof and supporting a presser-foot 8, and within which head is mounted the needle-bar x', carrying the needle x.

The needle-actuating means comprises a shaft 9, journaled in said arm 6 and having a crank 10 at one end thereof pivotally secured to the needle-bar x' and provided at its opposite end with the usual hand and pulley wheels 12 and 13, respectively. This shaft 9 carries a gear 14, which meshes with a gear 15, mounted on the end of an upright shaft 16, journaled in the upright part of the machine-arm 6, the lower end of which shaft is operatively connected with the looper-driving shaft 5 by a train of gears 17 for imparting motion to the looper in a manner hereinafter fully set forth.

The feed mechanism shown, which is similar to that shown and described in Patent No. 574,573, referred to, and more particularly in Letters Patent No. 558,664, granted to me April 21, 1896, comprises a feed-actuating lever 18, pivotally supported for vertical and horizontal oscillations and carrying at one end thereof a feed-dog 19, working in the feed-slots of a throat-plate 20, and operatively connected at its opposite end with a cam 21, mounted on the shaft 16, and by means of which the feed-dogs are operated.

As before stated, the looper or shuttle A, so far as the bobbin-holding means and the number or kind of loop-takers are concerned, may be of any desirable construction; but the looper is herein shown as of discoidal form, provided with a V-shaped periphery 25, and is shaped to have therein an annular chamber 26, provided with a centrally-disposed hub or spindle 27 for the reception of a bobbin or spool 28 in the usual way, and which may be held therein in any desired way, preferably by the ordinary cap 30. The looper is provided with either one or more loop-takers, each of which is preferably formed by a peripheral recess 33, whereby the loop-takers are in the nature of hooks 34. In the construction of looper shown it is provided with a series of three hooks and will therefore be designed as a multihook looper.

In the form of looper shown in Fig. 1 it is not provided with a needle-slot, but is so constructed and disposed that the needle may reciprocate at one side thereof, this being accomplished by forming the looper of less angle at one side than at the other relatively to the peripheral line thereof and setting the same at a proper inclination with relation to the path of the needle. Each side of this looper is preferably constructed as a true mortise-gear, one side or gear being designated by D and the other by F, each side being formed with a series of true bevel-gear teeth, (designated by 40 and 41, respectively,) the preferred construction of which is best illustrated in Figs. 9, 10, 11, 12, and 13, Fig. 13 showing the angles of the pitch-cones of the looper, driver, and support, the line $o\ o$ in this figure representing the pitch-cone at one side of the looper, while the lines $m\ m$ and $n\ n$ represent, respectively, the outer ends and the bases or roots of the teeth thereof, and the line $o''\ o''$ represents the pitch-cone of the opposite side of the looper, and the lines $m''\ m''$ and $n''\ n''$ represent, respectively, the outer ends and bases or roots of the teeth at this side of the looper.

In Fig. 11 the full and dotted lines represent the looper as it would appear if formed with a full complement or circuit of teeth; but for reasons hereinafter set forth in connection with the driving mechanism it is deemed desirable to do away with a number of such teeth and have the remaining teeth disposed in segmental arcs and in position to engage with the teeth of the driver and support.

It will be understood that a greater or lesser number of teeth than are herein shown could be used, if desired; but in the present construction thereof the looper is shown having its teeth 40 at one side thereof comprising a series of six teeth and its teeth 41 at the opposite side thereof comprising a series of three teeth, and which teeth may be of any preferred width, the teeth 40 being disposed in pairs, each pair being equidistantly disposed relatively to the other pair, while the teeth 41 are also equidistantly disposed relatively to each other, but preferably alternating with the teeth 40, whereby a tooth at one side of the looper will be opposite a space at the other side thereof, and vice versa.

Each tooth 41 of the gear F and each tooth 40 of the gear D at opposite sides, respectively, of the looper or driven member have their outer ends preferably flush with the side face of said looper, the tooth spaces or sockets 44 and 42, respectively, between, and which determine the shape of, the teeth 40 and 41, respectively, constituting sockets for receiving the teeth or projections on the supporting members E and C, the latter of which constitutes the driver for the looper or driven member A.

All of the teeth at each side of the looper are preferably concentrically disposed about the axis of rotation of the looper and at points intermediate the periphery and axis thereof.

It will be understood that the long web 46, intermediate each pair of sockets or spaces 44 of the gear D, and the long web 47, intermediate each pair of sockets or spaces 42 of the gear F, may, to a certain extent, also constitute a tooth, in which case in this form thereof the looper would thus be considered as having at one side thereof six teeth 41.

The mechanism B, which, as before stated, comprises a driver C and a support E, each of which is a true bevel-gear, one disposed at

each side of the looper or shuttle and in mesh with the gear at that side thereof, may be sustained in any desired way; but in the preferred construction thereof herein shown, however, one of said devices, as C, which is shown as the main driver, is secured on the end of the driving-shaft 5 for rotation therewith. The preferred construction of this bevel-gear driver C is best illustrated in Figs. 7, 8, 12, and 13, in which the line o' o', Figs. 8 and 13, represents the pitch-cone thereof, while the lines m' m' and n' n' represent, respectively, the outer ends and the roots or bases of the teeth, and which bevel-gear driver would have the appearance, if provided with the usual complement of teeth, illustrated in Figs. 7 and 8, the non-working teeth being shown in dotted lines; but as in practice the bevel-gear looper and bevel-gear driver and support have their primitive cones of such a slight angle from a true plane the teeth thereof are therefore of such length that they remain nearly fully in mesh through such a relatively long arc of rotation that much the larger portion of the periphery and teeth of said driver and support can be cut away. Accordingly it has been found in practice to be entirely feasible when the driving-teeth are made in the form of truly-shaped gear-teeth, as herein set forth, to use only a small proportion of the usual complement of teeth for each of said peripheral arcs. Hence in the construction shown the driver is provided with a series of teeth 48, preferably disposed in sets of three, each set being equidistantly disposed relatively to the other sets and said teeth being formed by spaces 49 intermediate thereof, whereby they are adapted to mesh with the teeth 40 of the bevel-gear looper. These teeth 48 are concentric with the axis of the driver and are disposed at the same diametrical distance therefrom as the teeth of the looper are disposed from its axis. Owing, as above stated, to the relatively long arc of rotation through which the teeth of the looper and driver remain in mesh with each other in this particular construction of looper mechanism, a series of three sets of teeth is herein shown adapted to accomplish the purpose desired. Hence the remaining portion of the periphery of the driver intermediate each set of teeth is cut away, thus leaving a series of spaces 50, whereby a bevel-gear driver is formed having three radial arms or segments 51, carried by a hub 52 and equidistantly disposed relatively to each other and each carrying at its outer end a set of three bevel-gear teeth 48.

The support E, which forms the other member of the mechanism B and combined with the driver C thereof constitutes the sustaining means for the looper, as hereinafter more fully set forth, is to a certain extent in the nature of an idle-gear, and while said gear may be supported in many different ways from that herein illustrated, and normally freely movable toward and from the looper or not, it is, however, herein shown journaled in a swinging bracket 55, by means of which it is supported in position at that side of the looper at which the bobbin is usually inserted. This supporting-gear E is herein shown formed as a ring-shaped member, thus having an annular opening 63′ and provided with a series of teeth 57. Owing to the fact that a large proportion of such teeth can be cut away, for the same reason as above set forth in connection with the driver C, such series of teeth 57 is herein shown preferably comprising six teeth disposed in pairs, each pair being equidistantly disposed relatively to the other pairs thereof and each pair of teeth being formed by spaces or recesses 58 in the usual way, so that the support will have a series of six segmentally-disposed teeth and a series of six recesses 58 when considering the relatively long recesses at each side of a pair of teeth. These teeth are likewise disposed concentric with the axis of the support and at the same diametrical distance therefrom as the teeth of the looper with which they are to mesh are disposed from their axis. The construction of this support as a bevel-gear is best illustrated in Figs. 2, 3, 12, and 13, in which the line o''' o''' illustrates the pitch-cone thereof, while the lines m''' m''' and n''' n''' represent, respectively, the outer ends and the roots or bases of the teeth thereof.

From the foregoing it will thus be seen that the pitch-cones of the bevel-gear driver C and support E and the bevel-gears D and F of the looper are all preferably of corresponding angles and are so shown in the drawings, and that owing to the perfect rolling action of each companion pair of bevel-gears relatively to each other they have a perfect bearing engagement and can be actuated at a high degree of speed.

It will also be seen that owing to the fact that the bevel-gear driver and also the bevel-gear support has a considerable portion of its periphery cut away the sides of the shuttle or looper adjacent thereto can be formed of any desired contour—for instance, as convex or flat, the latter shape being preferably herein shown—without interfering with the meshing of the teeth.

As above stated, this bevel-gear support E is mounted in a swinging bracket 55, which is shown pivotally secured at one end to a projection or bracket 60, forming part of the framework of the machine, by means of a pintle or pivot 61, extending through a pair of ears 62 of said swinging bracket 55 and a pair of ears 62′ of the projection 60, the upper end of said pivot being threaded to enter a threaded aperture in the under side of the bed-plate 2. This swinging bracket 55 is provided with an annular opening 63, having its wall concaved to form one member of a race 64, the other member of which race 64 is formed by the hub 65 of the support E, which fits into said opening 63 of the bracket 55, and in which race suitable antifriction-bear-

ings, such as balls 66, are disposed. The gear is held in position by a flanged ring-shaped member or nut 67, preferably pressed into the hub 65 of the gear and turning therewith in the opening of the bracket. The bracket 55 is so constructed or disposed that the axis of the support E will be in an inclined plane and of course at an angle to the axis of the looper A, which likewise has its axis at an angle to the axis of the driver C, which in this form of mechanism is shown in a horizontal plane, although it might be otherwise, as hereinafter set forth. This bracket is held in position to support the gear in mesh with the looper by a suitable fastening device, one form of which is shown as a spring-catch 67′, Fig. 3, secured to a rib 68 on the under side of the bed-plate 2, while another form is shown as a screw-catch 69, Figs. 1, 4, and 6, having a threaded end engaging a threaded aperture in a projection or bracket 70 of the framework, in which case the bracket 55 is provided with a slot 70′, whereby on turning said screw-catch the head 69′ thereof will engage or release said bracket 55, as the case may be. Thus it will be seen that the bracket 55 can be swung outward to permit either the shuttle or the support to be removed, as desired; and as the annular openings 63 and 63′ of said bracket and support, respectively, are slightly larger than the bobbin and the cap 30 it will be readily seen that said bobbin can be placed in position and removed from its chamber in the looper without swinging the bracket from its normal operative position by simply inserting the same through said openings 63 and 63′ of the bracket and support, respectively.

In the form of looper and driver herein illustrated if the gear-teeth of each pair of intermeshing gears C and D and E and F, respectively, were left as formed the ends of the teeth thereof would therefore in this construction be insufficiently far apart at certain periods in the rotation of the looper to permit the proper passage of the thread-loop around said looper owing to the angle of the cone-faces of said gears, although other angles thereof might be used. Hence in the present structure a clearance space or passage is formed for the thread of the loop when carried around the looper, in order to permit the same to be properly drawn out and drawn up in the usual manner of this character of loopers, this being preferably accomplished in this instance by cutting away the outer ends of the gear-teeth of the gears C and D of said looper mechanism on inclined planes, as best seen in Fig. 13, in which the line *i i* represents the angle of inclination at which the outer ends of the looper-teeth are cut away at one side thereof and which also indicates the contour of the looper at that side thereof, while the line *j j* represents the angle of inclination at which the teeth of the driver C are cut away; but as in this construction the opposite side of the looper, as before stated, is of less angle relatively to the periphery thereof for the purpose of permitting the reciprocations of the needle it is deemed sufficient in this instance to cut away only the looper-teeth. Hence the line *k k* represents the angle of inclination at which such looper-teeth are cut away, and which line *k k* likewise indicates the contour of this side of the looper. From the foregoing it will thus be seen that a space 71 is formed intermediate the ends of the teeth of each driver, each support, and each looper-gear when the teeth of said driver and support are out of mesh with the looper-teeth, and which occurs approximately in the present construction when the looper and its driver and support are moving through that arc of rotation adjacent to the throat of the throat-plate 20, whereby the proper drawing out and drawing up of the loops are permitted, although it will be obvious that the disposition of the teeth will regulate to a large extent the particular point at which such teeth will be out of mesh with each other.

It will be understood that the angle of inclination at which the teeth are cut away may not only be varied to suit the particular form of shuttle, but in some forms of looper mechanisms could be dispensed with, and hence forms no part of the construction of the true bevel-gears as such, as it will be noted that the line of contact or rolling lines of the working faces of the gear-teeth conform to the laws relative to the construction and operation of bevel-gearing and are not modified by the incline of the ends of said teeth—as, for example, in some forms of looper mechanism—such, for instance, as that illustrated in Figs. 17 and 20—and in my prior application, Serial No. 605,796, filed September 14, 1896, the inclination of the teeth of the driver and support is shown greater than the inclination of the looper-teeth, whereby the points or apexes of the teeth will enter first at the outer ends thereof with a greater degree of inclination than otherwise and thereby cause the thread to pass from under the teeth should such teeth bite the same prematurely or the loop be carried beyond its normal drawing-up position. It will be clearly obvious, however, that to accomplish this purpose it is not necessary to cut away the said teeth at a greater angle of inclination than the looper-teeth, or vice versa, as it is sufficient in those forms of looper mechanism where the teeth are cut away on inclined planes to cut away the teeth of the driver or driver and support and looper at the same angle of inclination in view of the fact that in the constructions shown, like my previous application above noted, the looper and driver and support have their axes at an angle relatively to each other, so that the angles of inclination of the looper and driver and supporting-teeth cross each other when in mesh at the under side of the looper, and hence the apexes of said teeth enter the looper recesses or spaces first and with sufficient inclination to thus cause the thread to

pass from under the teeth should there be any tendency to bite the same prematurely. In order that these gears will constitute the supporting means for the looper, and thus do away with peripheral or other independent supporting means, and in order, also, that such supporting means will have a bearing engagement with the looper with such a high degree of precision that the separation or dislocation of the coacting or bearing parts thereof will be positively prevented, and thus radial or diametrical vibratory as well as lateral movement of said looper likewise prevented, the top and bottom faces 75 and 76, respectively, of the teeth 48 and 47 of both gears, which in bevel-gears as usually made are formed flat or conical, are in this construction formed truly spherical, and the top and bottom walls 77 and 78 of the spaces 42 and 44 at each side of the looper, respectively forming the looper-teeth, are likewise formed truly spherical, whereby said gears and looper-gears will have a bearing engagement of coinciding spherical surfaces bearing the one upon the other, whereby they will thus have curved bearing-faces in a plane transverse to the plane of rotation of said looper and gears, as indicated by the dotted circles 79 and 80, Figs. 2, 8, 12, and 13, so as to support and maintain the looper in proper position relatively to the gears and to the path of the needle, with relation to which in this construction it is supported at an angle. Thus it will be seen that the teeth of the driver and support engage the looper at each side thereof, respectively, during that period of their rotation in which they are in mesh and between its center and its periphery, thereby supporting the looper in space, as it were, and without the use of other independent means of support, and thus doing away with a peripheral track or track-rolls, and in this construction it will also be seen that the teeth of one gear are in alternation with the teeth of the opposite gear owing to the disposition in alternation of the looper-teeth, as hereinbefore stated.

It will be observed, of course, that the teeth 48 and 57 of the driver and support are cut away intermediate the axis of said driver and support and the under faces 76 thereof for the purpose of forming such under faces spherically-shaped, as above set forth, and it will be understood that the teeth might be of any desired length, the teeth of the looper of course preferably corresponding therewith.

From the foregoing it will thus be seen that the top and bottom walls 77 and 78 of the spaces of each looper-gear and the top and bottom faces 75 and 76 of the teeth of the driver and support, respectively, are in coinciding spheres, as best illustrated in Figs. 12 and 13, whereby they are thus concentric to a common axis, the axis 81 being the axis of the gear-faces C and D, while the axis 82 is the axis of the gear-faces E and F, whereby, owing to these coinciding spherical bearing-faces, the looper will not only be supported as above set forth, but said looper and its driver and support will be held together when in mesh with each other with such a true bearing-engagement that radial or diametrical vibratory movement of the looper is avoided, as well as lateral movement thereof.

It will also be noted that as the looper and driver and support are formed as true bevel-gears the teeth thereof also constitute a means for preventing radial or diametrical movement of the looper independently of the coinciding spherical bearing-faces in a similar manner as in the looper mechanism of my prior application hereinbefore referred to, Serial No. 605,796, filed September 14, 1896, as the teeth of such looper and driver and support, being true bevel-gear teeth, they therefore taper toward the center of said looper, driver, or support, respectively, and thus form wedge-faces in a diametrical or radial direction, whereby the looper-teeth are wider at their outer faces *g g*, Fig. 11, than at their inner faces *h h*, and when fully in mesh with the teeth of the driver and support, which are likewise wider at their outer faces *r r*, Fig. 7, than at their inner faces *s s*, diametrical or radial movement of the looper is prevented, as will be readily understood on inspection of said figures, in which the looper, Fig. 11, for the purposes of this illustration, will be considered having its working teeth disposed in sets of three instead of pairs, so that they will properly mesh with the number of working teeth shown in this instance on the driver, and while in the operation of those forms of looper mechanisms which are not provided with a full number of teeth there are certain periods in the rotation thereof in which the teeth are not fully in mesh, owing to the fact that the teeth are disposed in segments or separated peripheral arcs, yet during these periods the opposing sides—as, for instance, *t t'* of a pair of teeth 48 of a pair of radial arms 51 of the driver, Fig. 7—will be in such position relatively to the opposing sides *u u'* of a pair of teeth 41 of the looper that they also form wedge-faces, and thus prevent diametrical or radial movement of such looper.

It will be further noted that in the present form of looper mechanism the teeth of the looper bevel-gears are preferably somewhat thicker or wider than the teeth of the drivers. In order to constitute an additional means for steadying the looper should the same have any tendency to move upward or laterally, a guide 85 is secured to the under side of a part of the framework-bracket 3 and is provided with a V-shaped groove 86, the inclined walls of which are thus in position to engage the periphery of the looper during its rotation.

In the form of looper mechanism shown in Fig. 15 the construction of the looper and the driver and supporting-gears is substantially similar to that just described, except that one of the gears, as E, is of less diameter than

the other gear C, and hence the teeth of the looper at that side thereof adjacent to said gear are disposed somewhat nearer the axis of said looper to mesh with such gear-teeth. In this construction, however, the driver C is shown provided with a series of six teeth 48, adapted to mesh with a series of three teeth 40 of the looper, while the supporting-gear E is shown provided with a series of three teeth 57, adapted to engage in a similar number of spaces 42 in the looper, and which spaces thus form three relatively long teeth 90. In this construction the smaller gear E is shown carried by a shaft 91, journaled in a bracket 92, sliding in ways 93 on the under side of the bed-plate 2, whereby in order to remove the shuttle or the bobbin it is simply necessary to slide said gear away from the looper. The bracket 92 is shown provided with a locking device in the nature of a spring-actuated bolt 94, operable to engage a recess 95 in said bed-plate, and thus maintain the gear E in mesh with the looper-gear F. On releasing the bolt 94 by means of a pin 96, projecting through a slot 97 of the bracket 92, said bracket and its gear can be moved away from said looper. It will be understood that this gear E might be supported in a similar manner, however, to the gear E shown in Fig. 1 or in any other desired way, and it is therefore illustrated in this form of looper mechanism as sliding for the purpose simply of showing this means of support. In this construction, however, the gear E is preferably supported so that its teeth will be in alternation with the pairs of teeth of the driver-gear C.

In the construction of looper mechanism shown in Figs. 17, 18, and 19 a somewhat different form of looper A is supported between a pair of gears C and E, each of which has its shaft-axis in this instance in an inclined plane and both preferably at the same angle of inclination, whereby the looper is supported in a plane in alinement with the vertical plane of the needle-path and both of said gears being normally non-movable toward and from the looper. This combination, however, of various constructions, it will be understood, is not necessary to the working of the looper mechanism, as this form of looper might be supported by the same construction of driver and supporting-gear shown in Fig. 1 or Fig. 15, or the driver and supporting-gear shown in Fig. 17 might sustain a different construction of looper, or one of the gears might be secured in position for movement toward and from the looper in a substantially similar way to that shown in Fig. 1 or Fig. 15. It will therefore be understood that the combination is simply for the purpose of illustrating in one figure some of the various ways in which this invention can be carried out. In this construction both gears C and E are provided with the same number of teeth, and each is herein shown having a series of six teeth 48 and 57, respectively, disposed in pairs, whereby a pair of gears similar to the driver C, Fig. 1, but with a less number of teeth, however, are secured. These gears preferably have their shaft-axes at the same angle of inclination as above stated, whereby the looper will be supported at an angle to each gear, but in a plane in alinement with the path of the needle. The looper is provided with a series of three teeth 40 and 41 at each side thereof respectively and formed in a similar manner to the teeth of the bevel-gear F of the looper shown in Fig. 1, the teeth at one side, however, not being in alternation with the teeth at the opposite side. The idle-gear E in this case is supported by a bracket 100, secured to the under side of the bed-plate 2 by suitable fastening devices, such as screws 101, whereby it is normally non-movable toward and from the looper except by detaching such screws. The looper in this construction has its needle-slot 102 formed substantially in its periphery and not at a relatively remote distance to one side thereof, as is usually the case, this being permitted owing to the fact that the looper is not peripherally supported by track-rolls or other means, as in ordinary mechanisms of this character. The loop-takers, which are in the nature of hooks 103 and comprising one or more, as is necessary, have their outer loop-engaging ends or points 104 preferably bent slightly inward instead of outward, as is usually the case, whereby they will form a close engagement with the needle. In this construction the teeth of the gears and looper are cut away in inclined planes, as in that form thereof shown in Fig. 1; but the inclination of the teeth as compared with the inclination of the looper-teeth or with the outlines of the shuttle is preferably such that the points or apexes thereof will first enter at the outer ends, as hereinbefore stated.

In the construction shown in Fig. 20 both the gears C and E and also the looper are provided with a full number of teeth, which are constructed in a similar manner to the teeth of the other gears heretofore described, but are, however, herein shown as relatively wide teeth, the ends thereof being cut away on inclined planes to form a thread-passage in a similar manner to the mechanism illustrated in Fig. 17.

In Figs. 21 and 22 is shown a looper having only the inner walls 78′ of its tooth-spaces 42 and 44 spherically shaped, the outer walls thereof being cut away, thus permitting the outer faces 75′ of the teeth of the driver and supporting-gears to be formed non-spherically shaped or in the usual way and only the inner faces 76′ thereof spherically shaped. In this instance the teeth of the two looper-gears are not shown in alternation, although they may be so disposed, if desired.

Having described my invention, I claim—

1. In a sewing-machine, the combination of looper mechanism comprising a looper hav-

ing gear-teeth at each side thereof; a driver having gear-teeth meshing with the teeth on one side of the looper; and a rotatable support having gear-teeth meshing with the teeth on the other side of said looper.

2. The combination, with needle mechanism including a reciprocatory needle and actuating means therefor, of looper mechanism including a rotary looper having two sets or two series of mortise-gear teeth formed, respectively, on opposite sides thereof; two rotary looper-supporting members disposed at relatively-opposing angles at opposite sides of the looper, with their axes inclined to the axis of said looper, and having teeth or projections disposed to enter and coöperate with the walls of the sockets or spaces between the teeth of the looper, whereby to support said looper; and means operative with the needle mechanism for rotating one of said members and the looper supported thereby in proper timing with the needle.

3. In a sewing-machine, the combination, with a reciprocatory needle and an actuator therefor, of rotary looper mechanism including a rotary looper disposed below, and at an angle to the path of movement of, the needle and having two sets of teeth formed on opposite side faces, respectively thereof; two rotary looper-supporting members located at opposite sides, respectively, of the looper, with their axes oblique to the axis of the looper, and each having a series of teeth or projections disposed to enter and coöperate with the walls of the sockets between the teeth of the looper whereby to support the same, and the outer faces of the teeth of one supporting member describing a path whose plane is at right angles to the axis of said member and intersects the peripheral plane of the looper at a point below the axis of said looper; and actuating means in connection with the needle-actuator and effective for rotating one looper-supporting member and the looper in proper timing with the needle.

4. The combination, with needle mechanism including a reciprocatory needle and actuating means therefor, of looper mechanism including a rotary looper formed with two sets or two series of bevel-gear teeth on opposite sides, respectively thereof, the outer faces of which teeth are flush with the outer faces of said looper; two relatively oblique looper-supporting members located at opposite sides, respectively, of said looper and having bevel-gear teeth coöperative with the bevel-gear teeth of said looper for wholly supporting the looper, and said supporting members being so disposed as to engage the teeth of the looper at one side, and slightly above, the axis of rotation of said looper and disengage the teeth of said looper at the opposite side, and slightly above, said axis, whereby an intermeshing engagement is maintained throughout more than one-half of each complete cycle of rotation of said looper; and means operative with the needle mechanism for driving one supporting member whereby to rotate the looper in proper timing with the needle.

5. The combination, with needle mechanism including a reciprocatory needle and actuating means therefor, of looper mechanism including a rotary looper supported below at an inclination to the path of the needle and having a series of pairs of gear-teeth formed on each side face thereof, the pairs of each series being equidistantly disposed relatively to each other, and the spaces or sockets between one series of teeth being disposed intermediate, or alternating with, the spaces or sockets between the teeth of the other series; two obliquely-disposed rotary looper-supporting members located at opposite sides of the looper, and each having a series of pairs of projections or teeth disposed to enter the gear-tooth spaces or sockets in the adjacent face of the looper, and the pairs of teeth of one supporting member being disposed intermediate, or alternating with, those of the other member; and means for rotating one of said members.

6. A rotary looper mechanism for sewing-machines, embodying two bevel-gears supported with the front faces of the teeth of one in a plane oblique to the plane of those of the other; a discoidal looper having two sets of two series of bevel-gear teeth on opposite side faces, respectively thereof, which are complemental to the teeth of the bevel-gears, and said looper being wholly supported between, and having those teeth below the axis thereof in intermeshing engagement with the teeth of, said bevel-gears; and actuating means in connection with one of said bevel-gears.

7. Looper mechanism for a sewing-machine, comprising a looper and driving and supporting mechanism, the said mechanism consisting of rotatable gears located in position to support the looper at each side thereof intermediate its periphery and axis, one of said gears being movable toward and from the looper.

8. A looper mechanism for sewing-machines, comprising a rotary looper having two sets of gear-teeth formed on opposite sides, respectively thereof, and each set comprising a series of equidistantly-disposed pairs of teeth, and the spaces or sockets between the teeth having spherical inner and outer end walls; two relatively-oblique rotary supporting members disposed at opposite sides, respectively, of the looper, and each member having a series of equidistantly-disposed pairs of gear-teeth whose inner end faces are spherical and coöperate with the spherical end walls of the spaces or sockets between the gear-teeth of the looper for supporting said looper, and both of which supporting members are so disposed that certain pairs of teeth thereof will engage the looper below the axis of rotation of said looper, while another pair thereof will be out of engagement with said looper above

said axis, combined with means for rotating one of said members and the looper supported between said members.

9. In a sewing-machine, the combination, with framework, of rotatable looper mechanism comprising a looper; a driver journaled for rotation on said framework and in engagement with the looper; a swinging bracket pivotally supported on said framework; and a rotatable support carried by said bracket and movable therewith toward and from the looper for engagement with the same.

10. In a sewing-machine, the combination, with framework, of rotatable looper mechanism comprising a looper; a driver journaled for rotation on said framework and in engagement with the looper; a bracket supported on said framework and movable toward and from the looper; means for fastening said bracket in position; and a rotatable support carried by said bracket and movable therewith toward and from the looper, for engagement with the same.

11. In a sewing-machine, the combination, with framework, of rotatable looper mechanism comprising a looper; a driver journaled for rotation on said framework and in engagement with the looper; a movable bracket secured to said framework and having an annular opening or recess; and a rotatable support journaled in the recess of said bracket and also having an annular recess or opening and movable with said bracket toward and from the looper, for engagement therewith.

12. In a sewing-machine, the combination, with framework, of rotatable looper mechanism comprising a looper; a driver journaled for rotation on said framework and in engagement with the looper; a movable bracket secured to said framework and having an annular opening or recess, the walls thereof forming one member of a race or track; a rotatable support journaled in the recess of said bracket and also having an annular recess or opening and movable with said bracket toward and from the looper, for engagement therewith, the outer wall thereof forming the other member of said track or race; and antifriction-bearings in said race.

13. The combination with rotatable looper mechanism comprising a looper and driving and supporting mechanism, said looper and mechanism having coinciding spherical bearing-surfaces at each side of the peripheral line of said looper, whereby the looper is both supported and driven by said mechanism, and whereby also radial or diametrical vibratory movement thereof is prevented.

14. The combination with a rotatable looper; of a pair of gears, one of which is a driving-gear, supported for rotation one at each side of said looper, and said looper and gears having coinciding spherical bearing or engaging surfaces whereby the gears constitute supporting means for said looper, and whereby also radial or diametrical vibratory movement of the looper is prevented.

15. In a sewing-machine, the combination of rotatable looper mechanism comprising a bevel-gear looper and a pair of bevel-gears, one of which is a driving-gear, supported one at each side of said looper, and said looper and gears having coinciding spherical bearing-surfaces, whereby the gears constitute supporting means for said looper, and whereby also radial or diametrical vibratory movement thereof is prevented.

16. The combination of rotatable looper mechanism comprising a bevel-gear looper having a series of spaces at each side thereof forming true bevel-gear teeth, each of said spaces having spherically-shaped upper and lower walls; and a pair of bevel-gears supported for rotation one at each side of said looper and also having bevel-gear teeth adapted to mesh with the looper-teeth and having the top and bottom faces thereof spherically shaped, whereby the looper and gear-teeth have coinciding spherical bearing-faces to thereby support the looper and prevent radial or diametrical vibratory movement thereof.

17. The combination of rotatable looper mechanism comprising a bevel-gear looper having true bevel-gear teeth and a pair of bevel-gears, one supported at each side of said looper, and also having true bevel-gear teeth adapted to mesh with the teeth of the looper, the teeth of said looper and one or both of said gears having their outer ends cut away on inclined planes to form a thread-passage at each side of said looper.

18. The combination of rotatable looper mechanism comprising a looper, and a pair of gears supported for rotation one at each side of said looper, said looper and gears having bevel-gear teeth adapted to mesh with each other and the teeth of the looper and of one or both of said gears having the outer ends thereof cut away on inclined planes to form a thread-passage at each side of the looper, the teeth of the gear or gears being cut away at a greater angle of inclination than the teeth of said looper.

19. In a sewing-machine, the combination of rotatable looper mechanism comprising a bevel-gear looper having a series of spaces at each side thereof, thereby forming true bevel-gear teeth, each of said spaces having spherically-shaped upper and lower walls; and a pair of bevel-gears one supported for rotation at each side of said looper, each of said gears also having true bevel-gear teeth adapted to mesh with the looper-teeth and having the top and bottom faces thereof spherically shaped, whereby the looper and gears have coinciding spherical bearing or engaging faces at each side of said looper to thereby support the looper and prevent radial or diametrical movement thereof, and said looper and one or both of said gears having the outer ends of their teeth cut away on inclined planes to form a thread-passage at each side of the looper.

20. In a sewing-machine, the combination

of a rotatable looper mechanism comprising a bevel-gear looper having a series of sockets or spaces at each side thereof forming bevel-gear teeth, each of said spaces or sockets having spherical inner and outer end walls; and a pair of bevel-gears supported for rotation one at each side of said looper, and the teeth of said gears meshing with the looper-teeth and having spherical inner and outer end faces coinciding with the spherical bearing-faces at each side of said looper and coöperating therewith to support and prevent diametrical vibratory movement of said looper, and said looper and one or both of said gears having the outer ends of their teeth cut away in inclined planes to form a thread-passage between the teeth of the bevel-gears and looper at each side said looper, and the teeth for said gear or gears being cut away at a greater angle than the teeth of the looper.

21. The combination of rotatable looper mechanism comprising a bevel-gear looper having a series of bevel-gear teeth at each side thereof and a pair of bevel-gears supported for rotation one at each side of said looper, and each of said gears also having bevel-gear teeth of less width than said looper-teeth and adapted to mesh therewith.

22. The combination of rotatable looper mechanism comprising a bevel-gear looper having a series of spaces at one side thereof forming a series of six bevel-gear teeth disposed in pairs and a series of spaces at the opposite side thereof forming a series of three teeth, each of said spaces having spherically-shaped upper and lower walls; a pair of bevel-gears supported for rotation one at each side of said looper, one of said gears having a series of nine teeth disposed in sets and the other gear having a series of six teeth disposed in pairs and adapted to mesh with the looper-teeth and having the top and bottom faces thereof spherically shaped, whereby the looper and gears have coinciding spherically bearing or engaging faces constituting means for supporting said looper and also preventing radial or diametrical vibratory movement thereof.

23. The combination of rotatable looper mechanism comprising a bevel-gear looper having a series of spaces at each side thereof forming true bevel-gear teeth, the spaces at one side of said looper alternating with the spaces at the opposite side thereof, and a pair of bevel-gears supported for rotation one at each side of said looper and each having bevel-gear teeth adapted to mesh with the looper-teeth to impart motion thereto, and one of said gears having a larger number of teeth than the other.

24. A looper mechanism for sewing-machines, embodying a looper having the opposite side faces thereof constructed as mortise-gears, each gear including a series of sets of teeth separated by sockets or recesses having curvilinear inner and outer end walls, and said teeth having their outer faces flush with the side face of the looper, and means complemental to, and coöperative with, the teeth and sockets of both mortise-gears for supporting and rotating the looper.

25. A sewing-machine having a series of bevel-gear teeth formed on opposite side faces thereof, the spaces or sockets between which teeth have spherical inner and outer end walls concentric to each other, combined with means including two rotary members located at opposite sides, respectively, of the looper and having teeth or projections complemental to the teeth of the looper, and the outer and inner end faces of which teeth are spherical and concentric and coöperate with the spherical end walls of the sockets between the teeth of said looper, for supporting said looper, and one of which members constitutes a looper-driver.

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