May 9, 1967 E. SCHOIJ 3,318,274

TAKE-UP MECHANISM AND DRIVE MECHANISM FOR SEWING MACHINES

Filed March 5, 1964 8 Sheets-Sheet 1

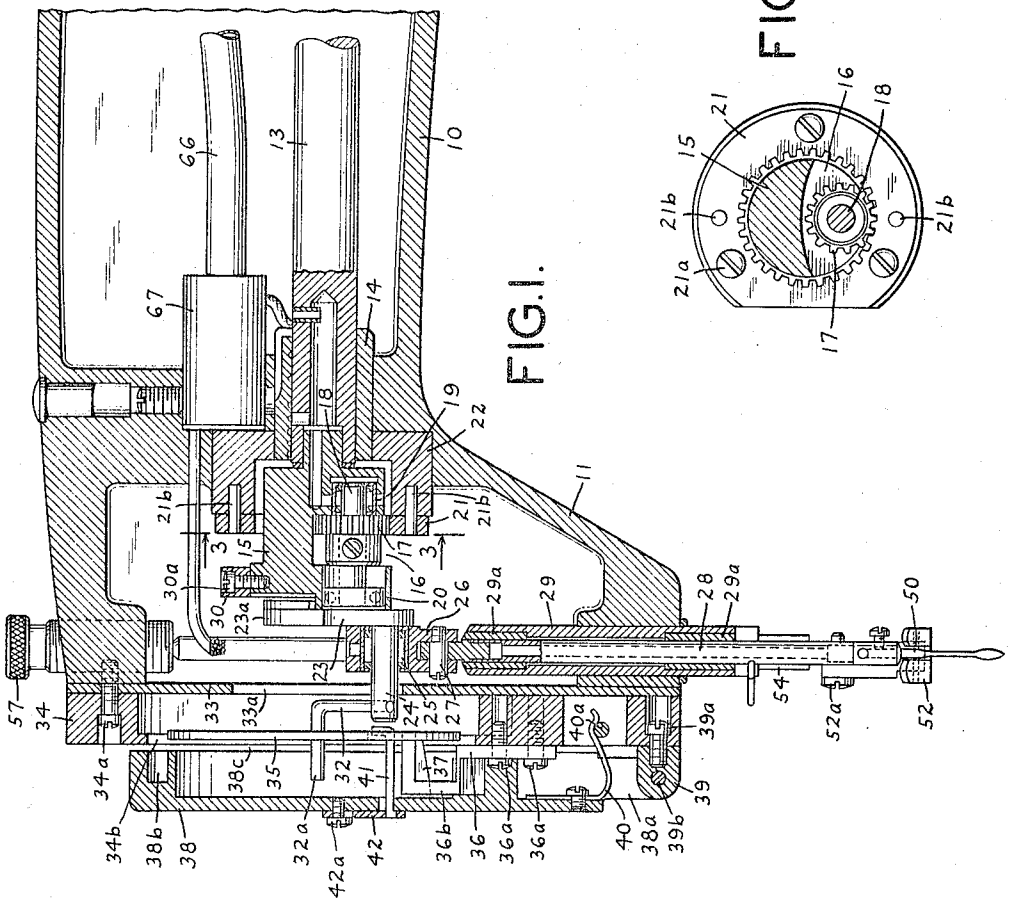


FIG. 1.

FIG. 3.

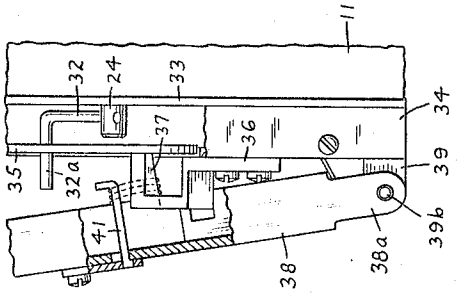


FIG. 2.

TAKE-UP MECHANISM AND DRIVE MECHANISM FOR SEWING MACHINES

Filed March 5, 1964 8 Sheets-Sheet 2

FIG. 4.

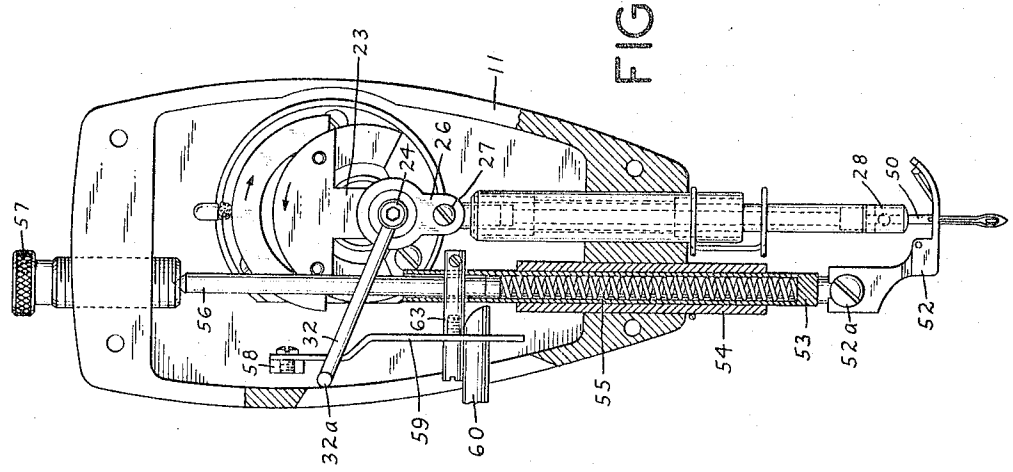
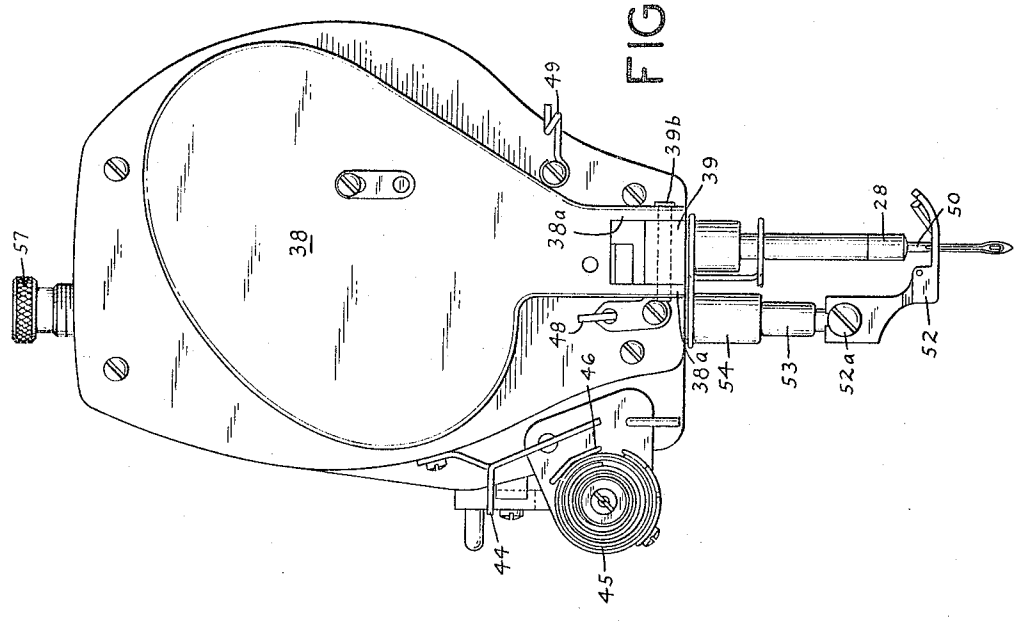


FIG. 5.



TAKE-UP MECHANISM AND DRIVE MECHANISM FOR SEWING MACHINES

Filed March 5, 1964 8 Sheets-Sheet 3

FIG.9.

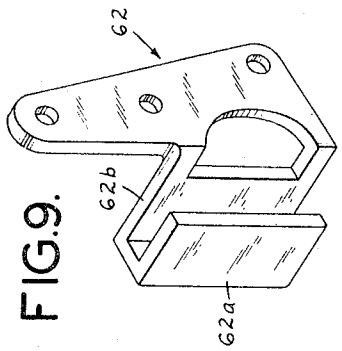


FIG.10.

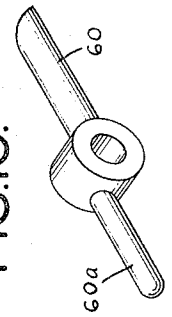


FIG.7.

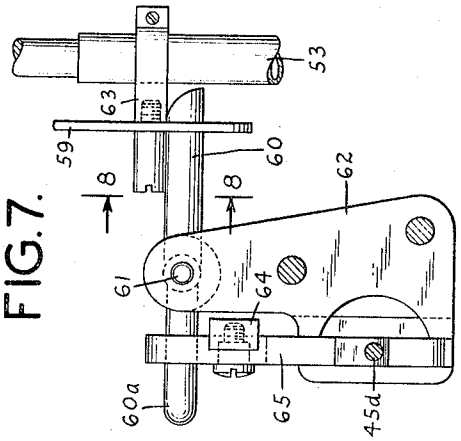


FIG.8.

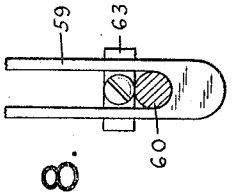
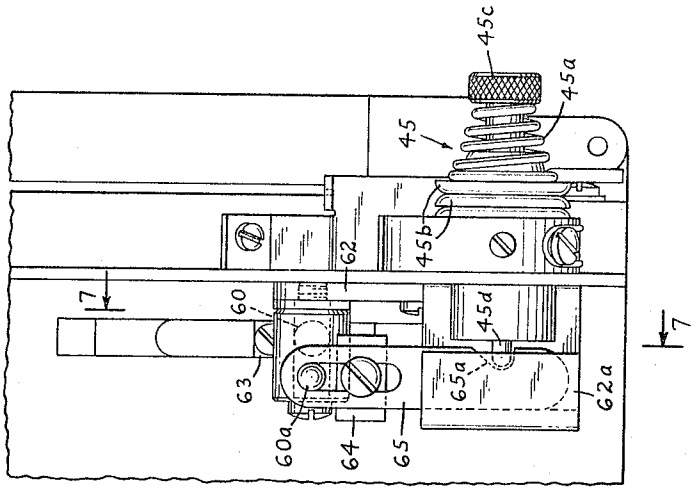
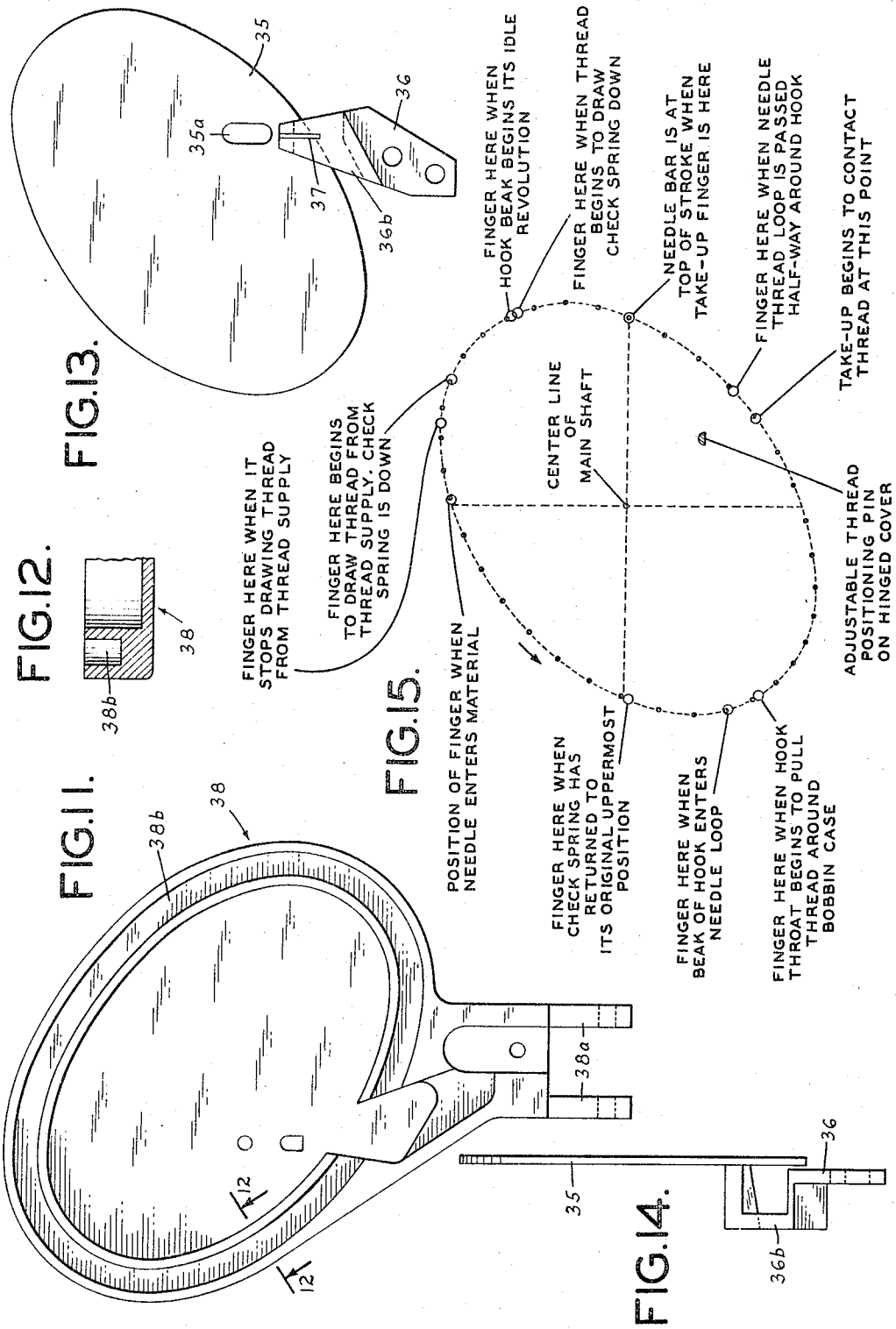


FIG.6.



TAKE-UP MECHANISM AND DRIVE MECHANISM FOR SEWING MACHINES

Filed March 5, 1964 8 Sheets-Sheet 4



TAKE-UP MECHANISM AND DRIVE MECHANISM FOR SEWING MACHINES

Filed March 5, 1964 8 Sheets-Sheet 5

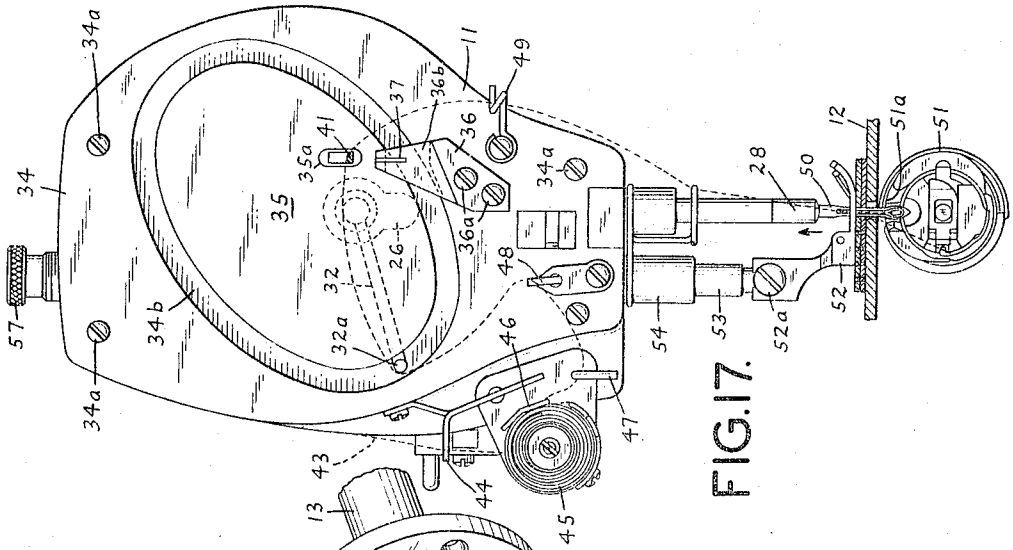


FIG. 17.

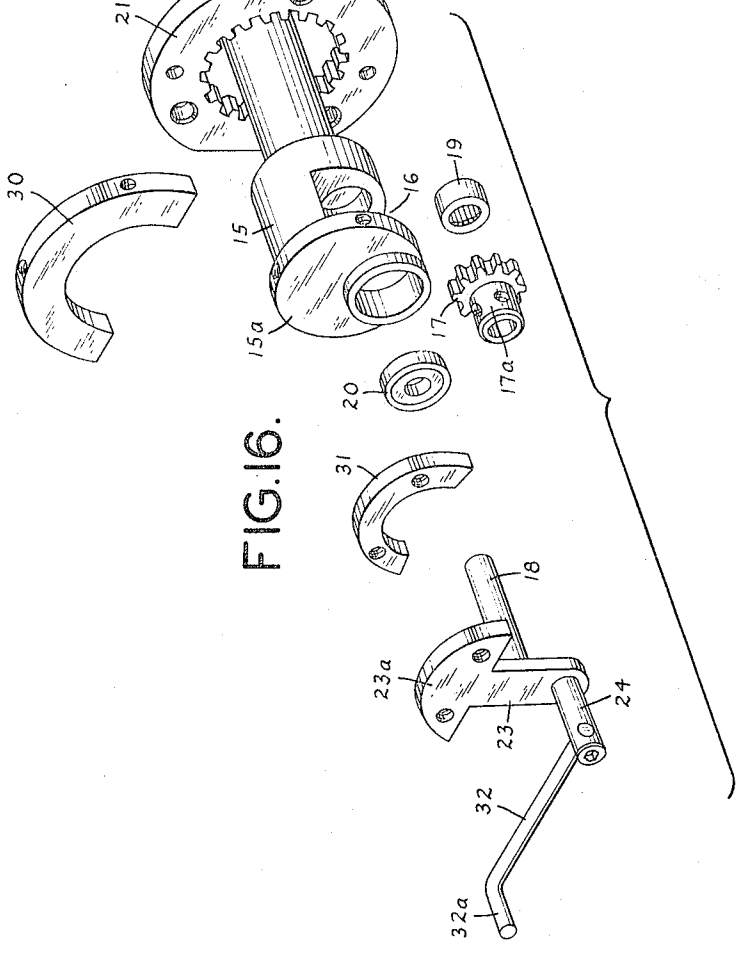


FIG. 16.

TAKE-UP MECHANISM AND DRIVE MECHANISM FOR SEWING MACHINES

Filed March 5, 1964 8 Sheets-Sheet 6

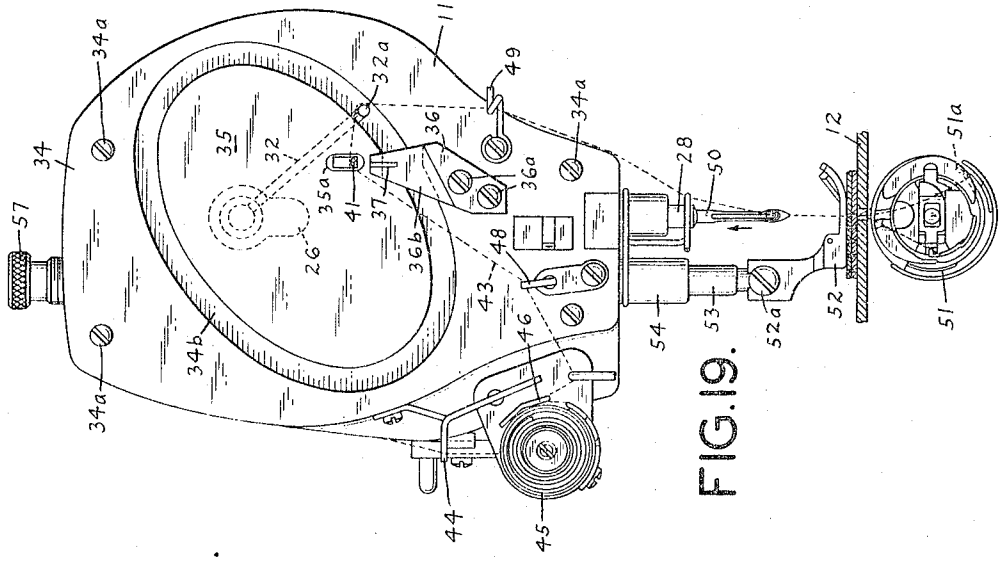
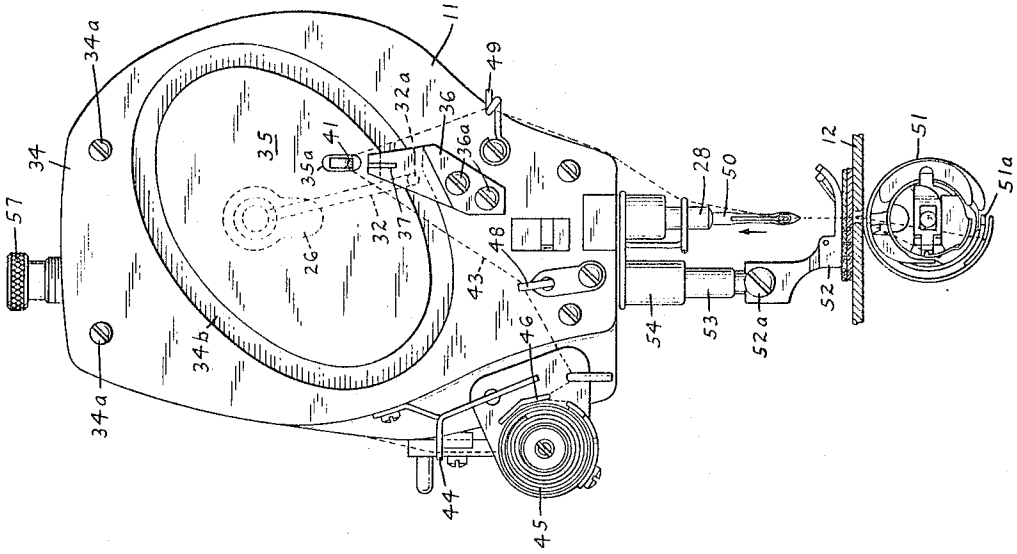


FIG. 19.

FIG. 18.



TAKE-UP MECHANISM AND DRIVE MECHANISM FOR SEWING MACHINES

Filed March 5, 1964 8 Sheets-Sheet 7

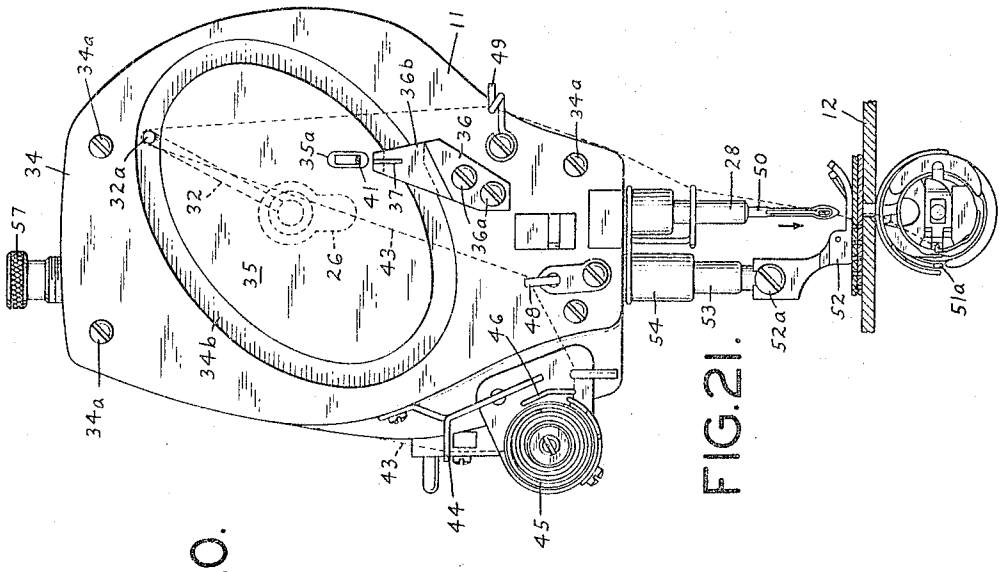
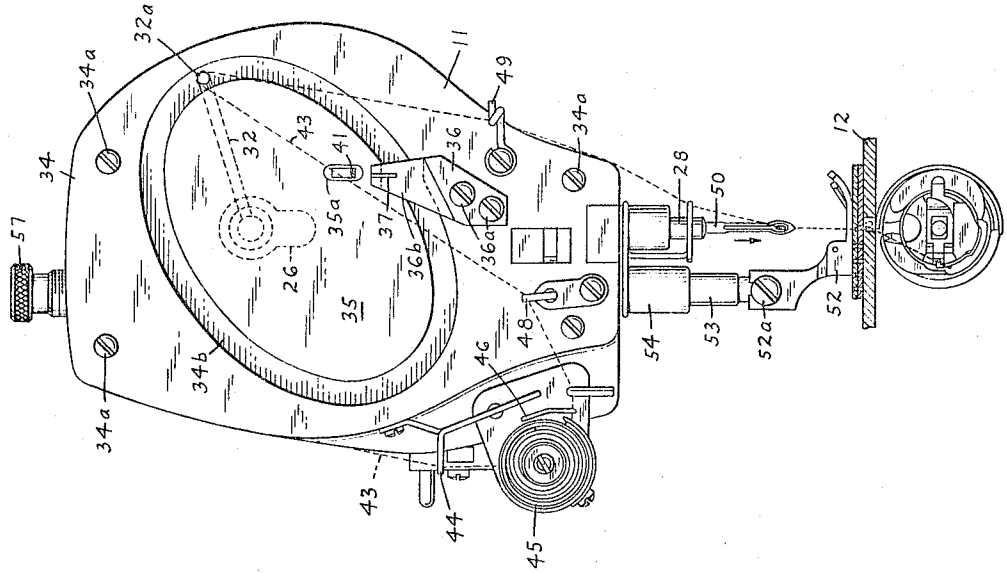


FIG. 21.

FIG. 20.



TAKE-UP MECHANISM AND DRIVE MECHANISM FOR SEWING MACHINES

Filed March 5, 1964 8 Sheets-Sheet 8

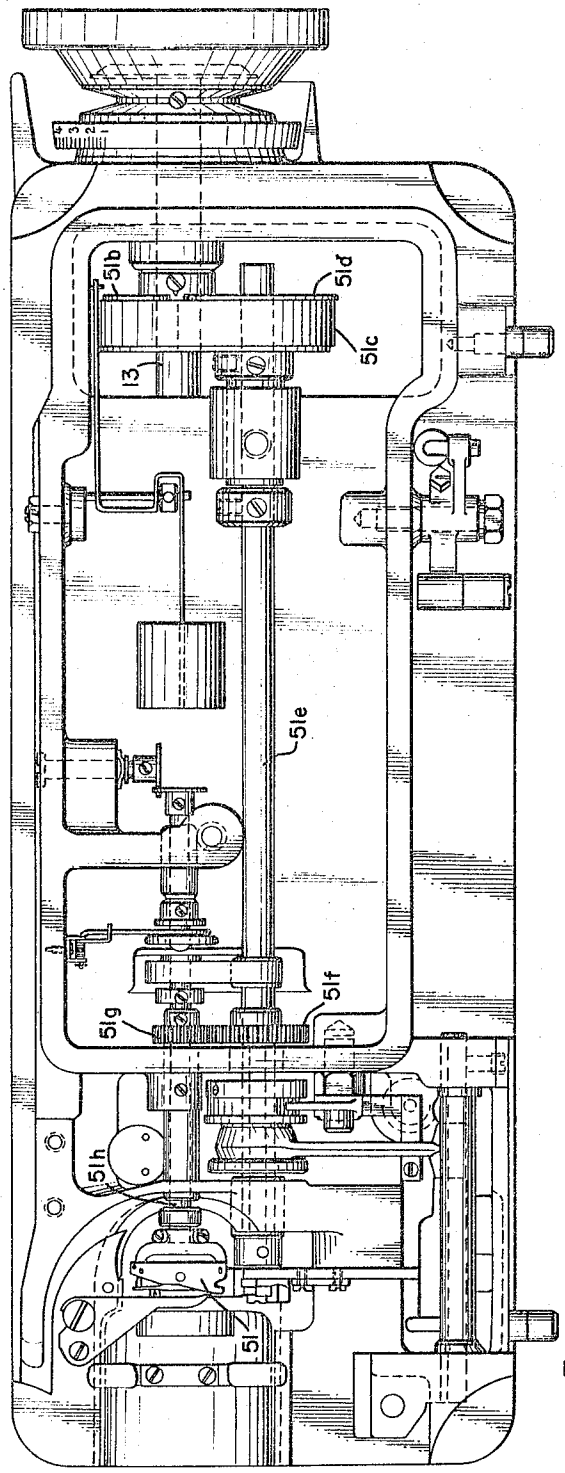


FIG. 22

INVENTOR

EDGAR SCHOIJ

United States Patent Office

3,318,274
Patented May 9, 1967

1

3,318,274

TAKE-UP MECHANISM AND DRIVE MECHANISM FOR SEWING MACHINES

Edgar Schoij, Hinsdale, Ill., assignor to Union Special Machine Company, Chicago, Ill., a corporation of Illinois

Filed Mar. 5, 1964, Ser. No. 349,702
24 Claims. (Cl. 112—248)

This invention relates to novel needle-thread takeup mechanism and balanced drive mechanism from the main drive shaft of a high speed, industrial sewing machine. It is particularly concerned with such machines adapted to produce a lockstitch seam involving the cooperation of a rotary hook with a reciprocatory needle. However certain features of the invention are applicable to other types of industrial sewing machines.

The improved take-up mechanism involves a thread engaging and shifting finger or the like which is moved through an elliptical or oval path upon each revolution of the main drive shaft of the machine. The arrangement is such that the finger which is moved through an elliptical path is advanced at different linear speeds in different portions of the path of movement. This enables the finger to exert a pull upon the thread and a release of any pulling force upon the thread at the particular times and at desirable speeds in a cycle of operation of the machine in which these actions are to be performed. By virtue of the particular construction contemplated by the invention, the danger of entanglement of the thread with moving parts of the mechanism of the machine is prevented, and the take-up action is smoothly imparted to the thread so that the danger of thread breakage due to the application of a take-up force is reduced to a minimum.

It has been found that to achieve the purposes of the invention most effectively, it is desirable to bring about movement of the thread engaging element along an elliptical path having its major axis disposed at a substantial angle to both the vertical and the horizontal, and preferably at an angle of about 38 degrees to the horizontal. To bring about the desired path and variation in speed of movement of the take-up finger, the preferred embodiment of the invention provides the take-up finger at the end of an arm which is swung, i.e. rotated, about an axis adjacent the other end thereof that is reciprocated in a vertical direction to a substantial extent during each cycle of operation of the machine. Thus the thread engaging element is given a compound movement which is a combination of the rotary swinging of its carrying arm about an axis adjacent the remote end of the arm, and of the bodily reciprocatory movement of that axis along a straight line. In a preferred form of the invention, as applied to a lockstitch machine, the major axis of the elliptical path is approximately 1½ times the minor axis of such path.

The timing of the thread engaging element, i.e. its rate of movement, in the various portions of the elliptical path is such as to meet the requirements of the stitch forming elements for the needle thread, and the need for imparting a pulling force to such thread for stitch setting purposes and for pull-off of the thread from the source of supply.

2

The improved balancing forces and vibration reducing forces imparted to certain parts of the driving mechanism is such as to offset forces created by the reversal of movement of reciprocating parts of the mechanism, as well as the change in speed of movement of the take-up element in the movement of the latter along an elliptical path. To achieve these purposes the invention contemplates a predetermined relationship between certain counterbalancing elements and between these and other parts of the mechanism.

A further feature of the present invention is the provision of means for quickly removing sections of thread, that may be caught within the frame, whenever a breakage of the thread happens to occur in the course of operation of the machine. This aspect of the invention involves the provision of means for preventing the thread from becoming wrapped about a moving element within the machine frame which would tend to accumulate an excessive amount of thread upon its breakage in the course of operation of the machine. The arrangement is such that any thread tending to wrap itself around any element within the machine frame, upon breakage of the thread, will become wrapped about two normally stationary elements. One of these is carried by an outwardly swingable cover plate, while the other is secured in fixed position and is provided with a cutting blade which is normally completely out of the path of the thread. When a section of the thread wraps around the two elements referred to, the outward swinging of the cover carrying the first mentioned element will automatically bring about the shearing of the loops of thread so wrapped. The first mentioned element, moreover, serves as a guide for the thread during certain portions of each cycle of operation of the machine. This is due to its relationship to certain fixed thread guiding elements and the take-up element discussed above. To insure proper operation of the first mentioned element, this is preferably mounted adjustably on the swingable cover member.

In accordance with the invention special means are provided for removing the tension normally applied to the needle thread whenever it is desired to remove completed work from the machine. This contributes toward the high speed operation of the machine as a whole.

Other features and advantages of the invention will appear from the detailed description of a preferred embodiment of the same which will now be given in conjunction with the accompanying drawings in which:

FIG. 1 is a vertical sectional view taken longitudinally through the head portion of the overhanging arm of a sewing machine embodying the invention;

FIG. 2 is a side elevational view, partly in section, of a portion of the frame and the end closure member for the head, said closure member being swung outwardly from the position shown in FIG. 1;

FIG. 3 is a detail view in vertical section along the line 3—3 of FIG. 1;

FIG. 4 is a view, partly in elevation and partly in vertical section, of the end of the head of the frame, showing certain parts within the latter;

FIG. 5 is an end view of the head of the machine, in vertical elevation, showing certain parts connected therewith;

FIG. 6 is an enlarged detail view of members carried by the head of the frame, as seen from the left in FIG. 5;

FIG. 7 is a detail view of a bracket member and related parts taken along the line 7—7 of FIG. 6;

FIG. 8 is a detail view of certain parts taken along the line 8—8 of FIG. 7;

FIG. 9 is a perspective view of a bracket member shown in elevation in FIGS. 6 and 7;

FIG. 10 is a perspective view of a rock member shown in FIG. 7;

FIG. 11 is an elevational view of the inner face of the end cover plate for the head portion of the upper arm of the frame;

FIG. 12 is a cross-sectional view taken along the line 12—12 of FIG. 11;

FIG. 13 is an elevational view of a part secured to the head of the frame of the machine just inside of the cover member shown in FIG. 11;

FIG. 14 is a side elevational view of the member shown in FIG. 13, as seen from the right of FIG. 13;

FIG. 15 is a diagrammatic view showing the path of movement of the take-up finger of the invention, the spacing of the dots indicating the distance through which the finger travels in the direction of the arrow for each 10° of rotation of the main drive shaft of the machine;

FIG. 16 is an exploded perspective view of parts in the connections from the main drive shaft to the take-up finger;

FIGS. 17 through 21 are views, taken from the left end of the head of the machine as shown in FIG. 1, illustrating a number of different positions assumed by the take-up finger, the needle and a rotary hook during a revolution of the main shaft; and

FIG. 22 is a bottom plan view of the machine with a bottom plate removed.

Referring now to the above-mentioned drawings, these show the features of the present invention applied to a lockstitch sewing machine of the general character of that disclosed in the U.S. patent to Covert No. 2,977,910, granted Apr. 4, 1961. It comprises a frame having an overhanging arm **10** terminating in a head portion **11** (FIG. 1). Beneath the overhanging arm is a base portion, of which only that part which is below the head portion **11** of the arm is indicated at **12** in FIGS. 17–21 inclusive. Extending longitudinally of the overhanging arm is a main drive shaft **13** which, as will be understood, is adapted to be driven through a pulley and handwheel mounted thereon adjacent its right end (not shown). This shaft is journalled in suitable bearings carried by the frame, including a bearing **14** (FIG. 1) adjacent the left end of the shaft. An extension **15** secured to the left end of the shaft extends into the head portion **11** of the arm.

As best shown in FIGS. 1, 3 and 16, the extension **15** of shaft **13** is provided with a cut away region **16** adapted to accommodate a pinion **17** and related parts. Pinion **17** has a hub extension **17***a* by which the pinion may be secured through set screws to a shaft **18**. This shaft is journalled at its right end (FIG. 1) in a roller or needle bearing unit **19** carried by extension **15**, and is journalled toward its left end in a ball bearing member **20** carried by the extension **15**. Pinion **17** meshes with an internal gear ring **21** secured by screws **21***a* to an annular member **22** fixedly mounted within the head portion of the overhanging arm to retain the member **21** in fixed position. Pins **21***b* cooperating with alined openings in members **21** and **22** serve to insure proper mounting of member **21** in relation to the frame of the machine.

To the left of the ball bearing unit **20** there is secured to the shaft **18** a rotary crank member **23** having a counterweight portion **23***a*. Crank arm **23** has secured thereto, adjacent its outer end, a pin **24** which cooperates with a roller or needle bearing unit **25** carried by a connecting link **26**. The lower end of this link is connected by a screw stud **27** with an upwardly extending head portion of a reciprocatory needle bar **28**. The latter is mounted for vertical reciprocation within bearing elements **29***a* in a sleeve **29** carried by the head portion **11** of the frame.

For applying a force to counterbalance that resulting from the reciprocation of the needle bar, that would otherwise produce objectionable vibrations, a horseshoe-shaped counterweight member **30** is secured by screws **30***a* to a slightly enlarged portion **15***a* of shaft extension **15**. For similar purposes a horseshoe-shaped counterweight member **31** is secured by screws to the face of the portion **23***a* of crank **23**.

Now assuming that the shaft **13** and its extension **15** are rotated in a clockwise direction, as seen from the left in FIGS. 1 and 16, the arrangement above described will serve to carry the pinion **17** and its supporting shaft **18** in a clockwise direction. Meshing of the teeth of pinion **17** with the internal gear teeth of member **21** will cause the pinion **17** and its shaft **18** to rotate in a counterclockwise direction. As a result of the clockwise bodily movement of the pinion when the parts are in position as shown in FIGS. 1 and 16, the counterweight **30** has its center of mass above the axis of mainshaft **13**. Therefore, it will be seen that in approaching this position, the counterweight **30** tends to exert a force having a vertically upward component as the needle bar **28** approaches its lowermost position and as it begins its upward movement. When mainshaft **13** has been rotated through an angle of 180° and pinion **17** has been correspondingly rotated in the opposite direction, the center of mass of counterweight **30** will be below the axis of shaft **13** so that a downward component of inertia force will be created as the needle bar approaches its uppermost position and begins its movement downwardly.

When needle bar **28** is in either its highest position or lowest position, it exerts a maximum inertia force which is opposed by an equal and opposite inertia force created by counterweight **30** and certain parts associated therewith. As the needle bar moves toward the center of its stroke, its inertia force gradually diminishes until, at the center of its stroke, it is at its zero force. The inertia force of counterweight **30**, when not in a strictly vertical direction has components in both a vertical and horizontal direction and for limited times only in a horizontal direction. The horizontal component of the inertia force created by counterweight **30** and associated parts would place the needle bar mechanism in a completely unbalanced condition if it were not for the equal and opposite horizontal component of the inertia force created by counterweight **31** and associated parts, including portion **23***a* of crank member **23**.

While extension **15** is cut away to accommodate the pinion **17** and its associated parts, the weight of the latter will substantially offset any centrifugal inertia force that might otherwise be created by the non-cut-away portion of extension **15**.

Therefore, it can be seen from the above that the gradual increasing and decreasing vertical inertia force of the needle bar **28** is always opposed by the gradual increasing and decreasing vertical component of the inertia force created by counterweight **30** and the parts associated therewith. The gradual increasing and decreasing horizontal inertia force component of counterweight **30** is always opposed by the gradually changing horizontal inertia force of counterweight **31**. Of course, when the needle bar **28** is at the center of its stroke and at zero inertia force, counterweight **31** and associated parts is exerting a maximum horizontal inertia force that opposes the maximum horizontal inertia force of counterweight **30** and the parts associated therewith.

In connection with the foregoing it will be mentioned that the pitch diameter of pinion **17** is one half of the pitch diameter of the internal gear teeth of member **21**. Also it should be mentioned that the construction is such that the axis of the pin **24** is at all times alined with the pitch circle of the pinion **17**. This arrangement is such

that the axis of pin **24** will partake of only a bodily reciprocatory movement, which is in a vertical plane passing through the axis of the needle bar **28** in a direction transverse to the direction of movement of the material being sewn.

As will be later described in detail, the present invention includes the provision of a thread take-up element **32** secured to the pin **24**, this element carrying a take-up finger **32***a*. In the highly preferred construction of the overall combination it has been found desirable to so form the rigidly connected parts illustrated in the drawings as crank **23**, **23***a*, counterweight **31**, pin **24** and take-up element **32** with its finger **32***a*, that this assembly has its center of mass always located in a horizontal plane passing through the axis of shaft **13**. When the needle is at the top or the bottom of its stroke, the center of mass of this assembly is positioned in axial alinement with the axis of the drive shaft **13**. At other points in a cycle of operation of the machine, the center of mass mentioned moves horizontally in a plane passing through the axis of shaft **13**. The end points of the motion of the center of mass within such horizontal plane are in horizontal alinement with the pitch circle of the internal gear **21**. Thus the extent of horizontal movement of the specified center of mass is the same as the vertical movement of the needle bar. Also the total mass of the specified parts is preferably made equal to that of the needle bar and its connected parts, including the link **26**, bearing **25** and the like. Since the inertia force involved in the movement of the specified assembly is at 90° to that involved in the reciprocation of the needle bar, a substantially uniform rotation imparting force is applied to the shaft **18** throughout the normal operation of the machine. This eliminates the production of torsional vibratory forces in the normal operation of the machine at any selected speed. The torsional forces required to rotate the shaft **13** are uniform at all constant speeds of rotation of said shaft. In connection with the foregoing it should be recognized that the pinion **17**, and shaft **18** and related parts are not considered to be a part of the assembly tied to crank **23** referred to above, since these elements rotate with the shaft **13** and are counterbalanced by the construction of extension **15** of that shaft and the counterweight **30**.

By the foregoing construction it has been found possible to completely balance the vertical and horizontal shaking forces applied to the frame of the machine, and the torsional forces applied to the drive shaft **13**, when the machine is operating at any selected speed. While certain specific devices, such as counterweights and the like, have been disclosed herein for achieving the purposes desired, it will be understood that other forms of mechanism may be used for bringing about the balancing of the various forces involved. This is particularly true with respect to the manner in which the assembly including crank **23** is constructed to insure the movement of its center of mass in a plane extending horizontally through the axis of the shaft **13**.

Returning now to the description of the illustrated embodiment of the invention, secured to pin **24** is the take-up element **32**. This has its main portion extending radially outwardly from the pin **24** in a direction at an angle to the longitudinal axis of the crank **23**. The angle at which element or arm **32** extends, in relation to the longitudinal axis of the crank **23** may vary between 45° and 90°, depending upon various aspects of the construction as a whole. As best shown in FIG. 4, in the embodiment herein illustrated the arm is inclined at an angle of about 60°, or slightly more, to the longitudinal axis of the crank **23**, in the direction in which the latter is turned about the axis of shaft **18** in the normal operation of the machine. At its outer end the arm **32** has a take-up finger **32***a* having its axis parallel with that of the pin **24**. It will be apparent from the foregoing description that as the drive shaft **13** is rotated in a clockwise direction, and the shaft **18** is rotated in a counterclockwise direction, the take-up finger **32***a* will be given a compound movement as a result of the movement of pin **24** along a vertical path and the swinging of the arm **32** about the axis of the pin **24**. The net result of this is to impart movement to the finger **32***a* along an elliptical or oval path. As shown in FIG. 15, this path is such that the elliptical path of the finger has its major axis inclined substantially to both the vertical and horizontal directions. In the preferred embodiment of the invention, the major axis of this path is inclined at an angle of about 38° to the horizontal. This may be varied within limits, if desired, but it has been found best for the purposes of the invention that said angle not exceed about 60° to the horizontal. Also it has been found best to have the form of the ellipse such that the length of its major axis is about 1.5 times that of its minor axis. As shown by the location of the dots in FIG. 15, which are indicative of the position of the finger **32***a* at each 10° interval in the rotation of the main drive shaft **13**, that the distance through which the finger is moved during successive 10° intervals varies somewhat. In some areas its actual speed of linear movement is much greater than in other regions of the complete cycle. This is an important consideration in the proper functioning of the take-up finger in its take-up action on the needle thread and its movement away from the taken-up thread to avoid interference with the action of other mechanism in the machine in dealing with the needle thread. Thus in the application of the invention to a lockstitch sewing machine it is important that the take-up finger advance sufficiently rapidly during certain portions of a cycle of the machine to enable a loop of the needle thread to be passed around the bobbin case of a rotary hook employed in a lockstitch sewing machine. At the same time it is desirable to eliminate an excessive production of slack in the needle thread to avoid danger of its entanglement in the operation of the machine.

To insure retention of the needle thread in proper relation to the take-up finger **32***a*, and for various other purposes to be described, special closure means are provided for the end of the head **11**. Such means include a plate **33** applied to the left end of the head **11** (FIG. 1), this plate having an opening **33***a* therethrough to permit the pin **24** to extend outwardly through the plate. Opening **33***a*, for this purpose, may simply be a relatively narrow one of rectangular form sufficient to accommodate the vertical movement of the pin **24** between its upper and lower limits. Plate **33** is secured to head **11**, along with an outer member **34**, by means of screws **34***a*. Member **34** is provided with an opening **34***b* through its outer face of substantially the same elliptical contour as the path of movement of the finger **32***a*. A slight clearance is provided by forming this opening slightly larger than the path of the take-up finger. Within the opening **34***b* is provided a plate **35** of substantially the same elliptical contour as the path of the take-up finger, with the outer periphery of this plate being spaced slightly inwardly of the path of movement of the finger at all points in the path of movement of the latter. Plate **35** is fixedly secured to the head of the arm by a bracket **36** which, as shown in FIG. 13, has its upper end welded or otherwise secured to an edge portion of the plate and has a downwardly extending part that is secured by screws **36***a* to the member **34**. The upper portion of element **36** is provided with an offset **36***b*, as best shown in FIGS. 1 and 14. Extending downwardly into the space within this offset is a knife blade or razor-like blade **37**, the function of which will be described. The take-up finger **32***a* in its travel through the elliptical path will pass around the outer edge of the plate **35**, and in a limited area will extend into the space within the offset **36***b*.

A closure member **38** (FIGS. 1, 5 and 11) has downwardly extending leg portions **38***a* adapted for pivotal mounting on a small block **39** secured by screws **39***a*

to the member **34**. A pivot pin **39***b* serves to connect the cover plate with the block **39** for pivotal movement. Normally the cover plate is held in its closed position indicated in FIG. 1 by means of a spring latch **40** cooperating with a pin **40***a* carried by member **34**. Whenever desired the cover plate **38** may be swung outwardly about pin **39***b* to any desired extent. On its inner face the cover plate has an elliptical passage or groove **38***b* having a contour corresponding with the path of movement of the take-up finger **32***a*. A slight clearance is provided between the walls of the groove and the pin to avoid any direct contact between these parts. A narrow passage **38***c* is provided between the inner face of the cover plate **38** and the opposed surfaces of the member **34** and plate **35**. This provides a space between the adjacent surfaces for the movement of the thread carried by the take-up finger in the course of its normal operation. It will be seen from the foregoing that the thread is well confined in the course of its movement in response to the action of the take-up finger, so that there is no danger of its slipping off of the end of the finger or becoming entangled with any parts in the normal operation of the machine. Adjustably secured to the cover plate is a thread guide **41**. This is secured to a plate **42** that is mounted for at least a limited amount of vertical adjustment by means of a screw **42***a* passing through a vertically elongated opening in the plate **42** and having threaded engagement with the cover member **38**. The inner end of thread guide **41** extends into an opening **35***a* in the plate **35** when the cover is closed. To permit the adjustment of guide **41** the opening **35***a* and also the alined opening through the cover member are vertically elongated as shown in FIGS. 1 and 13. These openings are also such as to permit some sidewise adjustment of the guide **41**.

Referring now to FIGS. 17–21 inclusive, the relative positions of various parts is shown at different points in a cycle of operation of the machine. In these figures the needle thread is shown in broken lines at **43**. It is delivered from a spool or cone (not shown) at the top of the machine downwardly along the rearward side of the frame to a guide member **44** having a suitable opening for the passage of the thread therethrough. From this point the thread extends downwardly to an adjustable thread tensioning device **45**. After passing through an arcuate path between the tensioning disks **45***b* of this device (see FIG. 6) the thread is passed around a check spring member **46** forming a part of the tensioning device and then downwardly to a fixed guide **47**. From the latter the thread extends toward the front of the machine and upwardly around an adjustable guide **48**, then over the take-up finger member **32***a* and over to the adjustable guide element **41**. From the latter the thread passes downwardly to another adjustable guide **49**, and from this down to the eye of a needle **50** carried by the needle bar **28**. In FIG. 17 the needle is shown in substantially its lowermost position and in the course of moving upwardly therefrom. The loop of needle thread produced by this slight upward movement of the needle is about to be seized by the beak **51***a* of a rotary hook **51**. It will be noted that at this time the take-up finger **32***a* is yielding some of the thread which it has previously carried upwardly. As disclosed in said Covert Patent No. 2,977,910, hereinabove mentioned, the rotary hook is driven at twice the angular speed of the main drive shaft, through connections of a conventional type shown in FIG. 22. As shown in said figure, the main drive shaft **13** of the machine has secured thereto a pulley **51***b* which is connected by a belt **51***c* with a pulley **51***d* secured to a shaft **51***e* extending longitudinally of the base of the frame of the machine. Shaft **51***e* has secured thereto a gear **51***f* which meshes with a pinion **51***g* secured to another shaft **51***h*. The latter has secured thereto the rotary component of the rotary hook **51**.

In FIG. 18 the parts are shown at a slightly later point in the cycle of rotation of the main drive shaft. The take-up finger has now been carried out of engagement with the needle thread so that the latter extends directly from the guide element **48** to guide element **41**. At the same time the beak **51***a* of the looper is carrying a loop of the needle thread around the bobbin case of the looper, and this may result in pulling downwardly to a slight extent on the check spring **46**, the thread thus being under a slight extra tension. As the parts reach the position shown in FIG. 19 the loop around the bobbin case is being released and the take-up finger **32***a* has engaged a portion of the thread to start the take-up action. Then proceeding to FIG. 20 it will be noted that the loop of thread has been completely withdrawn from the rotary hook and is about to be set in the fabric being sewn. At this stage of the cycle the take-up finger **32***a* is performing a further take-up action on the thread and has removed it from contact with the guide element **41**. Passing then to FIG. 21, it will be seen that the take-up finger **32***a* is in substantially its uppermost position. Just prior to reaching that position it will have served to draw a certain amount of thread from the source of supply to compensate for that used in the previous stitch formed and it will have drawn the check spring down to its lowermost position. After reaching the position of FIG. 21 the finger will no longer draw thread from the supply but will begin to create slack to a limited but gradually increasing extent. At this stage of the operation the rotary hook is passing through its idle revolution in which it does not seize the needle thread and carry it around the bobbin case. This will have begun slightly before the take-up finger reaches the position shown in FIG. 20. By the time the parts arrive back at the position shown in FIG. 17 the same steps as described above will be repeated. The various notations applied to FIG. 15 will assist in understanding the timing of the action of the take-up finger as described above. In connection with the foregoing it will of course be understood that the rotary hook is driven at twice the angular speed of the main drive shaft so that only alternate revolutions of the hook are effective in seizing a needle thread loop to form a new stitch.

In FIG. 4 the presser foot arrangement provided in the machine is shown. Thus a presser foot **52** adapted to engage the upper surface of the work being stitched and force the latter against the throat plate of the machine is connected by a screw **52***a* with the lower end of a largely tubular presser bar **53**. The latter is mounted for vertical sliding movement in a sleeve **54** carried by the head **11** of the frame. A spring **55** within the major portion of the presser bar serves to urge the latter and the presser foot downwardly under a desired pressure. At its upper end the spring engages an enlarged head of a rod **56** which is adapted for vertical adjustment to vary the force of spring **55** by the turning of a screw threaded member having a knurled head **57**. It will be apparent that the force of spring **55** may be reduced by turning the knob **57** to cause the pin **56** to rise slightly, and the pressure may be increased by turning the knob in the opposite direction. Work feeding mechanism of any desired form, such as that shown in the above-mentioned Covert Patent No. 2,977,910, may be used for advancing the work through the stitch forming zone.

When the hook is to be removed from the machine the presser bar **53** may be lifted by the operation of a lever **58**, of known form, connected with a knee press or treadle member for its rocking movement. When the lever **58** is operated to lift the end shown in FIG. 4, a downwardly extending link **59** secured thereto is adapted to perform the presser bar lifting action. For this purpose the lower end of the link **59** is slotted, as indicated in FIG. 8, and the lower end of the link is adapted to pull upwardly on an arm **60** (see also FIGS. 7 and

10) mounted for rocking movement about a pin **61** carried by a bracket member **62** shown in perspective in FIG. 9. This bracket is secured by suitable screws to the frame of the machine. As the arm **60** is thus rocked upwardly it engages and lifts an arm **63** secured in any suitable way to the presser bar **53**, thus lifting the presser foot away from the work against the action of spring **55**.

Means are provided for eliminating the tension applied to the needle thread by the tensioning device **45** as the presser foot is lifted in the manner explained. It will be understood that this does not occur when the presser foot and bar are shifted upwardly in the course of operation of the machine due to variations in the thickness of the work. The thread tensioning device **45** is provided with a spring **45***a* which normally urges the two disks **45***b* into engagement with each other. The thread **43**, as will be understood, passes between the disks **45***b* to have the desired tension applied thereto depending upon the force of spring **45***a*. This tension may be varied as desired by turning a knurled head **45***c* of a screw member to vary the amount of compressive force incorporated in the spring **45***a*.

To release the thread from the tension normally applied by the disks **45***b* when the presser foot is lifted by the action of element **59** in the manner explained, the member having arm **60** is provided with an oppositely extending arm **60***a* (FIGS. 7 and 10), the latter being rocked downwardly when the arm **60** is rocked upwardly. Downward rocking of arm **60***a* will cause it to engage a block **64** that is secured for vertical adjustment in relation to a slide member **65**. The latter is mounted for vertical movement in a passage between arms **62***a* and **62***b* of bracket **62** (FIG. 9). Slide **65** is provided with a recess or indentation **65***a* (FIG. 6) which cooperates with a pin **45***d* incorporated in the thread tensioning device **45**. As the slide **65** is forced downwardly by the downward rocking of arm **60***a* the inclined upper surface of the recess **65***a* will cause the pin **45***d* to be cammed toward the right and thus remove the force of spring **45***a* from the disks **45***b* in a manner well understood in the art. See Taylor Patent No. 3,099,236, granted July 30, 1963, for a suitable construction for the purpose. By so releasing the tension applied to the spring as the presser foot is manually raised in the manner explained, the removal of work from the machine along with a sufficient amount of needle thread to enable quick severance of the latter is brought about.

Means of the general character disclosed in the above-mentioned Covert patent are provided for insuring proper lubrication of the various bearing surfaces at the forward end of the arm **10** and in the head **11**. This includes a lubricant delivering tube **66**, a reservoir **67** and tubing and other passages for conveying the lubricant to the surfaces requiring lubrication.

It is believed clear from the foregoing description and the accompanying drawings that a machine constructed in accordance with the present invention serves to retain the relatively large section of needle thread within the machine in a quite definite position at all times. Thus even when the needle thread is put into a somewhat slack condition it is nevertheless well confined within a particular region so as to eliminate the danger of entanglement of one part of this thread with another part and to prevent its entanglement with moving parts of the machine. It is guided and confined to a desired path by such elements as the plate **35**, the take-up pin **32***a*, the inner face of the cover member **38** providing a relatively narrow passage **38***c* between it and the outer face of member **34** and the plate **35**, and by several adjustable guide elements **44**, **45**, **46**, **47**, **48**, **41** and **49**. Moreover with the provision of the counterbalancing elements **30**, **31** and **23***a* it is assured that the machine may be operated at exceptionally high speeds without the development of excessive noise and vibrations. Toward this end, the provision of various roller or needle bearing units and ball bearing means eliminates wear and the development of excessive heat in the high speed operation of the machine.

While the improved thread take-up means employed reduces to a minimum the danger of thread breakage in the course of high speed operation, some thread breakage is bound to occur on occasion. When it does occur, the free end of the thread from the point of breakage, particularly when the thread is under tension at the time of breakage, which is the most likely time for its occurrence, will wrap itself around the guide element **41** and the closely adjacent portion of the bracket **36** which carries the razor blade or knife element **37**. There is little or no danger of it becoming wrapped about a rapidly moving element such as the takeup finger **32***a*, because of the confinement of the path of the thread. However if it should become wrapped about this finger it will become rather quickly severed by the knife element **37**. There is accordingly little or no tendency of the thread to continue to wrap about any elements of the structure if the machine is continued in operation for an appreciable time after the breakage occurs. The operator will of course quickly notice any thread breakage and will stop the machine as promptly as possible. Such thread as may have become wrapped around the guide **41** and knife blade **37**, as shown in FIG. 2, may then be readily removed by simply opening the cover plate **38** outwardly, which will result in drawing the loops of thread across the cutting edge of knife **37** to enable quick removal of the accumulated thread.

Rethreading of the needle may be very simply and quickly accomplished due to the accessible location of the various guide elements and the provision of the passage **38***c* between the cover plate **38** and the member **34**. This enables the thread to be passed very readily over the take-up finger **32***a* and the guide element **41**.

While a preferred embodiment of the invention has been described and shown in some detail it will be understood that various changes may be made in the construction and arrangement of parts without departing from the invention as defined by the appended claims.

What is claimed is:

1. In a sewing machine having a frame with an overhanging arm with a head portion at its outer end, a drive shaft journalled in said arm, a reciprocatory needle bar mounted in the head portion of said arm, a needle carried by said bar, complementary means cooperating with said needle for producing a multiple thread stitch, connections from said shaft for reciprocating said needle bar and operating said complementary means to form a line of stitching, means for directing thread to said needle, thread take-up means in the path of said thread for imparting a take-up action thereto, connections from said shaft for operating said thread take-up means, the combination which comprises a rotary member in at least one of said connections from said drive shaft to said needle bar, said complementary means and said thread take-up means, said rotary member being mounted for rotation in a direction opposite to that of said shaft about an axis removed from but parallel with the axis of said shaft, means carried by said drive shaft providing a first center of mass eccentric to the axis thereof, and means carried by said rotary member providing a second center of mass eccentric to the axis of rotation of said rotary member, said two mass providing means being so constructed and arranged that their combined inertia forces provide an active component along the line of movement of said needle bar and have components that are opposite to each other in a direction transverse to that of the movement of said needle bar.

2. In a sewing machine as set forth in claim **1**, said second mass providing means being so disposed that the maximum inertia forces involved in the rotation of said rotary member are substantially equal to the maximum inertia forces involved in the reciprocation of said needle

bar and the connected parts reciprocated therewith, the two specified inertia forces operating at right angles to each other and so varying in magnitude as to provide a combined inertia force of equal magnitude in the regular operation of the machine.

3. In a sewing machine as set forth in claim 1, said rotary member being in the connections from said drive shaft to said needle bar, and said rotary member with parts rigidly connected therewith having the center of mass thereof arranged to reciprocate along a straight line through the same distance as the needle bar is reciprocated.

4. In a sewing machine as set forth in claim 2, the construction being such that the two specified inertia forces act along straight lines passing through the axis of the drive shaft.

5. In a sewing machine as set forth in claim 1, said thread take-up means having a thread engaging finger that is carried through an elliptical path upon each revolution of said drive shaft.

6. In a sewing machine as set forth in claim 5, the elliptical path of said thread take-up finger having its major axis inclined at not more than 60° to the horizontal.

7. In a sewing machine of the character set forth in claim 5, the elliptical path of said take-up finger having a major axis about 1.5 times the length of the minor axis thereof.

8. In a sewing machine of the character set forth in claim 3, the connections from said shaft which include said rotary member comprising a pinion carried by said drive shaft for orbital movement about the axis of the latter, said pinion being connected with said rotary member for rotation therewith, an internal gear fixedly connected with said frame, said pinion and gear having intermeshing teeth, and said pinion having one-half the pitch diameter of said gear.

9. In a sewing machine as set forth in claim 8, said connections from said drive shaft to said needle bar comprising a crank element connected for rotation with said pinion, and a pin carried by said crank element having its axis alined with the pitch circle of said pinion.

10. In a sewing machine as set forth in claim 9, said thread take-up means having an arm integrally connected with said pin carried by said crank element and extending radially therefrom.

11. In a sewing machine as set forth in claim 10, said thread take-up means having a thread engaging finger extending laterally from said arm in a direction parallel with said pin carried by said crank element.

12. In a sewing machine adapted to produce a lockstitch, said machine comprising a frame having an overhanging arm with a head portion, a bar carrying a needle mounted for reciprocatory movement in said head, a rotary hook cooperating with said needle to form a lockstitch, a rotary drive shaft in said frame, and connections from said drive shaft for reciprocating said needle and rotating said rotary hook, the combination which comprises a needle thread engaging finger adapted to impart a take-up action to said thread, connections from said drive shaft for operating said finger and imparting an elliptical path of movement thereto, said last mentioned connections comprising a second shaft parallel with but spaced from said drive shaft, a pinion secured to said second shaft, means connected with said drive shaft for carrying said second shaft in a circular path about the axis of said drive shaft, an internal gear having twice the pitch diameter of said pinion fixedly secured to said frame in the region of said head portion of said arm, said pinion and gear having interengaging teeth, a crank arm secured to said second shaft for circular swinging movement about the axis of the latter, a pin extending from said crank arm parallel with said second shaft in alinement with the pitch circle of said pinion, and an arm extending radially from said pin from which said finger extends parallel with said pin in spaced relation to the latter.

13. In a sewing machine as set forth in claim 12, said second shaft being journalled in rotatable bearing means mounted in said means connected with said drive shaft for carrying said second shaft.

14. In a sewing machine as set forth in claim 12, said arm extending radially from said pin being directed therefrom in a direction between 45° and 90° to the longitudinal axis of said crank arm in the direction in which said axis is advanced during operation of the machine.

15. In a sewing machine as set forth in claim 12, said arm extending radially from said pin being directed therefrom at such an angle to the longitudinal axis of said crank arm as to impart to said take-up finger an elliptical path of movement having its major axis inclined at least 30° to the vertical.

16. In a sewing machine as set forth in claim 12, said arm extending radially from said pin being directed therefrom at an angle of about 60° to the longitudinal axis of said crank arm.

17. In a sewing machine as set forth in claim 12, means carried by said head portion of the overhanging arm in a position rearwardly of and below the path of movement of said thread engaging finger for applying a frictional tensioning force to said thread, said last recited means comprising tension applying discs and a spring normally urging said discs together, a spring urged presser bar carrying a presser foot normally urged downwardly into engagement with the work being stitched, means operable at the will of the operator for lifting said presser foot away from the work, and connections from said last rectited means for offsetting the force of said spring which normally urges said tension applying discs together.

18. In a sewing machine adapted to produce a lockstitch, said machine comprising a frame having an overhanging arm with a head portion, a bar carrying a needle mounted for reciprocatory movement in said head, a rotary hook arranged to cooperate with said needle to form a lockstitch, a rotary drive shaft in said frame, and connections from said drive shaft for reciprocating said needle and rotating said rotary hook, the combination which comprises a needle thread engaging finger adapted to impart a take-up action to said thread, connections from said drive shaft for operating said finger and imparting an elliptical path of movement thereto, said last mentioned connections comprising an arm mounted for circular swinging movement about an axis parallel with that of said shaft, said finger being carried by the so-mounted arm and extending outwardly therefrom in a direction parallel with said axis, and means for shifting said axis about which said arm is swung up and down in a vertical plane.

19. In a sewing machine as set forth in claim 18, a cover member carried by said frame having an elliptical channel on its inner face into which said finger extends and along which said finger travels, and a plate spaced inwardly from said cover member, said finger being arranged to travel around the periphery of said plate.

20. In a sewing machine as set forth in claim 19, said plate having an elliptical contour conforming substantially with that of the path of said finger.

21. In a sewing machine as set forth in claim 19, a thread guiding pin extending inwardly from said cover into the path of a portion of the needle thread within said head of the frame, and a cutter blade secured to said head adjacent said thread guiding pin, said blade having a cutting edge facing away from said guiding pin and out of the path of normal movement of the needle thread.

22. In a sewing machine as set forth in claim 21, said cover member being pivoted for outward rocking movement away from said head, said outward movement of said cover member being adapted to draw any loops of thread which may become wrapped about said thread guiding pin and said blade across the cutting edge of said blade to sever said loops.

23. In a sewing machine as set forth in claim **22**, said thread guiding pin being mounted on said cover member for adjustable positioning thereon and in relation to said blade.

24. In a sewing machine as set forth in claim **18**, a plurality of thread guiding elements adjustably mounted on said head below the path of movement of said finger, one of said guiding elements being in the path of said thread in the advance of the thread toward said finger, and another of said guiding elements being in the path of said thread between said finger and the needle.

References Cited by the Examiner

UNITED STATES PATENTS

2,430,084	11/1947	Smith	112—248
2,715,883	8/1955	Mayer	112—248
2,749,863	6/1956	Johnson	112—248
2,887,970	5/1959	Backlin	112—248
2,895,441	7/1959	Engel et al.	112—248

JORDAN FRANKLIN, *Primary Examiner.*

G. H. KRIZMANICH, *Examiner.*