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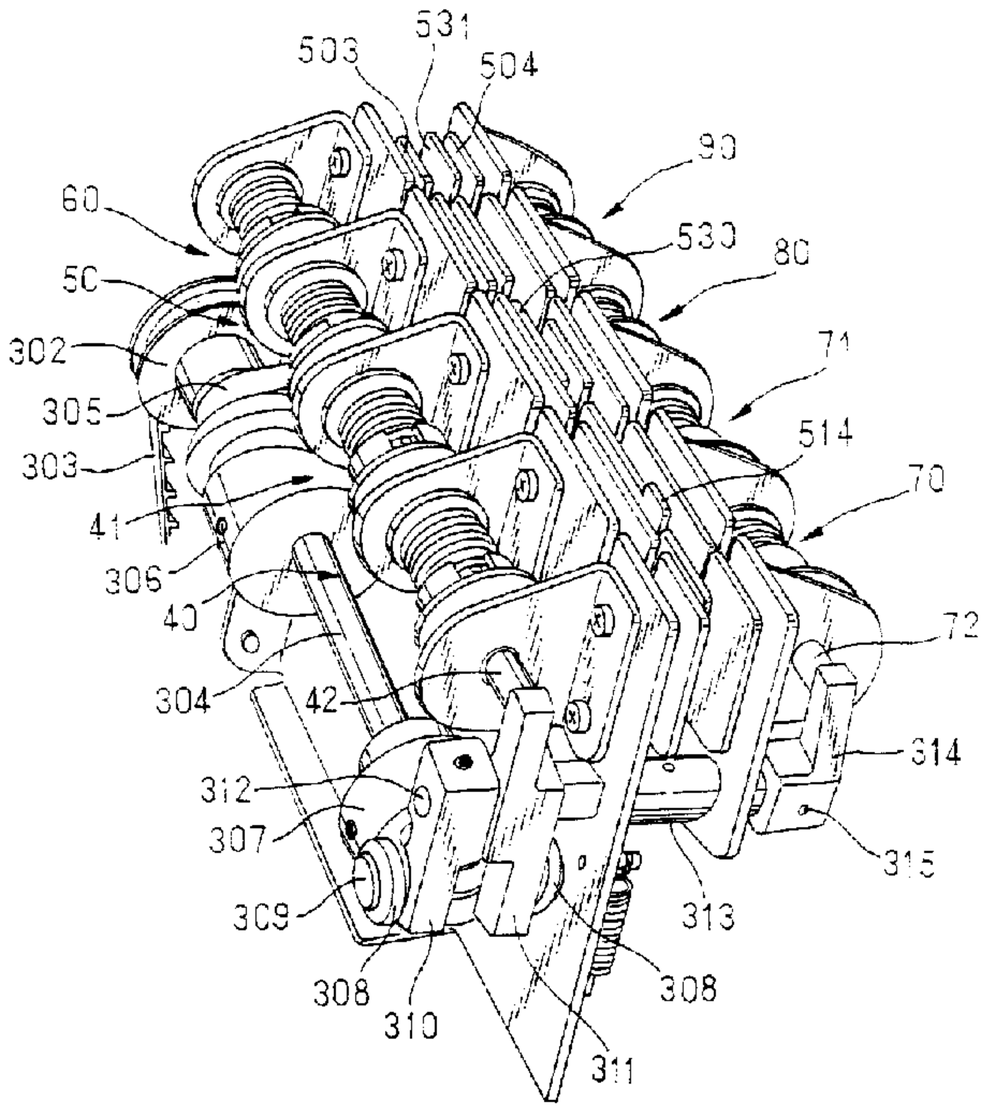


(57) Abrégé/Abstract:
A thread feeding apparatus for a sewing machine is disclosed which has a simplified mechanism to secure accurate manufacturing and improved durability to correspond to high speed sewing. The thread feeding apparatus for the sewing machine comprises upstream grippers for respectively gripping an upper looper thread and a lower looper thread, closed by a stitch forming device at a time of a stitch forming and opened at a time of a cloth feeding, downstream grippers for gripping the respective threads introduced from the respective upstream grippers, opened at a time of a stitch forming so that the respective threads are pulled by the stitch forming device and closed at a time of a cloth feeding, and reciprocators which are respectively driven in a synchronous manner with a left needle, a right needle, an upper looper and a lower looper, at a time of a cloth feeding, shift the respective threads of a thread path expanding between the respective opened grippers and the respective closed downstream grippers as a thread quantity necessary for a stitch of the stitch forming device and at a time of a stitch forming, release the respective threads.

Abstract of the Disclosure

A thread feeding apparatus for a sewing machine is disclosed which has a simplified mechanism to secure accurate manufacturing and improved durability to correspond to high speed sewing. The thread feeding apparatus for the sewing machine comprises upstream grippers for respectively gripping an upper looper thread and a lower looper thread, closed by a stitch forming device at a time of a stitch forming and opened at a time of a cloth feeding, downstream grippers for gripping the respective threads introduced from the respective upstream grippers, opened at a time of a stitch forming so that the respective threads are pulled by the stitch forming device and closed at a time of a cloth feeding, and reciprocators which are respectively driven in a synchronous manner with a left needle, a right needle, an upper looper and a lower looper, at a time of a cloth feeding, shift the respective threads of a thread path expanding between the respective opened grippers and the respective closed downstream grippers as a thread quantity necessary for a stitch of the stitch forming device and at a time of a stitch forming, release the respective threads.

THREAD FEEDING APPARATUS FOR SEWING MACHINE

The present invention relates to a thread feeding apparatus for a sewing machine, and particularly to a thread feeding apparatus for sewing machine in which a thread can be supplied to a stitch forming device for performing a stitch forming onto a cloth without the need for a stitch balancing thread tension.

The conventional lock stitch sewing machine or overlock sewing machine is provided with a thread tension device comprising a pair of thread tension discs held between thread tension springs at a predetermined pressing force, thereby holding a thread between the thread tension discs and adjusting a tension generated in the thread at a time of stitch forming by a needle or a looper to a predetermined value by means of the thread tension device so that stitch can be neatly finished even if the type and the thickness of the thread is changed. In this case, feeding of the thread is performed by drawing the thread tension device together with a needle thread take up or a looper thread take up and tightening stitches. In these sewing machines, a significantly complicated manual operation input for adjusting the thread tension device is necessary. Particularly, in the

overlock sewing machine, since the number of threads is increased, it is significantly more difficult to obtain a good balance of the tension among the threads.

Further, there is known a computer controlled overlock sewing machine which is provided with a pair of rollers each having an encoder and an electro-magnetic thread gripper so that the encoder measures a length of the thread, thereby opening and closing each of the electro-magnetic thread gripper so as to supply a thread quantity necessary for a stitch forming (Japanese Patent Unexamined Publication No. 2-45088). The computer controlled overlock sewing machine has a complex mechanism and requires a manual operation for previously inputting data concerning the type of thread, thickness of the thread, cloth thickness, stitch width and the like so as to determine the quantity of the thread. Accordingly, it is difficult to correspond the manual input to the finished stitch. Still further, in the computer controlled overlock sewing machine, since the roller forcibly supplies the thread even when the thread cut is generated, a waste thread is fed.

In order to solve the above problem, the applicant of this application has suggested a thread feeding apparatus for a sewing machine which can perform a suitable stitch balancing thread tension (Japanese Patent Unexamined Publication No. 9-19583). Since the thread feeding apparatus for a sewing machine employs a thread storing device which stores a thread as a thread quantity necessary for a stitch of a stitch forming device and removes the thread at a time of stitch

forming, there are problems because the mechanism becomes complex in that it is difficult to secure the accuracy of manufacturing, the durability thereof is low and the apparatus can not correspond to a high speed sewing machine. Further, the thread feeding apparatus for a sewing machine can not satisfy the consumers who require machines with a number of needles and a narrow hem or rolled hem sewing.

The present invention is achieved for the purpose of satisfying the above conventional requirements and an object of the present invention is to provide a thread feeding apparatus for a sewing machine which has a simplified mechanism to secure accurate manufacturing, to improve durability and to satisfy the requirement of high speed sewing.

In order to achieve the above object, in accordance with the present invention, there is provided a thread feeding apparatus for a sewing machine which feeds a thread to a stitch forming device for stitch forming on a cloth, the thread feeding apparatus comprising: an upstream gripper for gripping said thread fed from a thread spool, said upstream gripper being closed by the stitch forming device at a time of forming the stitch and opened at a time of feeding the cloth, a downstream gripper for gripping said thread introduced from the upstream gripper, said downstream gripper being open at a time of said stitch forming to allow said thread to be pulled by said stitch forming device and being closed at a time of feeding said cloth; and a reciprocator synchronously driven with said stitch forming device to shift said thread from a thread path extending between said open upstream gripper and said closed downstream gripper at the time of feeding the cloth to provide a thread quantity necessary for one stitch and to release said thread at the time of forming said stitch, said reciprocator being disposed between a pair of thread guides spaced between said upstream gripper and said downstream gripper and wherein said reciprocator has an inlet port for receiving said thread, a thread support at a point in

the thread path aligning with said pair of thread guides and a sloped surface for guiding said thread from the inlet port to the thread support.

Furthermore, in accordance with the present invention, there is provided a thread feeding apparatus for a sewing machine which feeds a needle thread, an upper looper thread and a lower looper thread to a needle, an upper looper and a lower looper, respectively, of a stitch forming device for forming a stitch in a cloth, the thread feeding apparatus comprising: a needle thread upstream gripper, an upper looper thread upstream gripper and a lower looper upstream gripper for gripping, respectively, the needle thread, the upper looper thread and the lower looper thread, the thread being respectively fed from thread spools, the upstream grippers being closed by the stitch forming device when forming the stitch and opened by the stitch forming device when feeding the cloth; a needle thread downstream gripper, an upper looper thread downstream gripper and a lower looper downstream gripper for gripping, respectively, the needle thread, the upper looper thread and the lower looper thread respectively introduced from the needle thread upstream gripper, the upper looper upstream gripper and the lower looper upstream gripper, opened at a time of the stitch forming so that the needle thread, the upper looper thread and the lower looper thread are pulled by the stitch forming device and closed at a time of cloth feeding of the cloth; and a needle thread reciprocator, an upper looper thread reciprocator and a lower looper thread reciprocator synchronously driven with the needle, the upper looper and the lower looper, respectively, shifting the needle thread, the upper looper thread and the lower looper thread in thread paths respectively expanding between the opened needle thread upstream gripper and the closed needle thread downstream gripper, between the opened upper looper thread upstream gripper and the closed upper looper thread downstream gripper and

between the opened lower looper thread upstream gripper and the closed lower looper thread downstream gripper at a time of cloth feeding of the cloth as a thread quantity respectively necessary for one stitch of the stitch forming device, and releasing the needle thread, the upper looper thread and the lower looper thread at a time of forming the stitch.

Further, in accordance with the present invention, there is provided a thread feeding apparatus for a sewing machine which feeds a needle thread, an upper looper thread and a lower looper thread to a needle, an upper looper and a lower looper, respectively, of a stitch forming device for performing a stitch forming onto a cloth, the thread feeding apparatus comprising: a needle thread upstream gripper, an upper looper thread upstream gripper and a lower looper upstream gripper gripping the needle thread, the upper looper thread and the lower looper thread respectively fed from a thread spool, closed by the stitch forming device at a time of forming the stitch and opened at a time of cloth feeding of the cloth; a needle thread downstream gripper, an upper looper thread downstream gripper and a lower looper downstream gripper gripping the needle thread, the upper looper thread and the lower looper thread respectively introduced from the needle thread upstream gripper, the upper looper upstream gripper and the lower looper upstream gripper, opened at a time of the stitch forming so that the needle thread, the upper looper thread and the lower looper thread are pulled by the stitch forming device and closed at a time of feeding the cloth; a needle thread reciprocator, an upper looper thread reciprocator and a lower looper thread reciprocator respectively shifting the needle thread, the upper looper thread and the lower looper thread in thread paths respectively expanding between the opened needle thread upstream gripper and the closed needle thread downstream gripper, between the opened upper looper thread upstream gripper and the closed upper looper thread downstream gripper and between the opened lower looper thread upstream

gripper and the closed lower looper thread downstream gripper at a time of feeding the cloth as a thread quantity respectively necessary for one stitch of the stitch forming device, and releasing the needle thread, the upper looper thread and the lower looper thread at a time of forming the stitch; a needle thread shifter, an upper looper thread shifter and a lower looper thread shifter for respectively adjusting a shift quantity shifted by the needle thread reciprocator, the upper looper thread reciprocator and the lower looper thread reciprocator of the thread path in correspondence to a thread quantity necessary for one stitch which changes in response to a stitch width for performing the stitch forming to the cloth, stitch length and/or a cloth thickness by a pressure foot; and a change-over means for displacing the needle thread shifter, the upper looper thread shifter and the lower looper thread shifter in correspondence to a number of the needle and/or a stitch width of the cloth.

Still further, in accordance with the present invention, there is provided a thread feeding apparatus for a sewing machine which feeds a needle thread, an upper looper thread and a lower looper thread to a needle, an upper looper and a lower looper, respectively, of a stitch forming device for performing a stitch forming onto a cloth, the thread feeding apparatus comprising: a needle thread upstream gripper, an upper looper thread upstream gripper and a lower looper upstream gripper gripping the needle thread, the upper looper thread and the lower looper thread respectively fed from a thread spool, closed by the stitch forming device at a time of forming the stitch and opened at a time of cloth feeding of the cloth; a needle thread downstream gripper, an upper looper thread downstream gripper and a lower looper downstream gripper gripping the needle thread, the upper looper thread and the lower looper thread respectively introduced from the needle thread upstream gripper, the upper looper upstream gripper and the lower looper upstream gripper,

opened at a time of the stitch forming so that the needle thread, the upper looper thread and the lower looper thread are pulled by the stitch forming device and closed at a time of feeding the cloth; a needle thread reciprocator, an upper looper thread reciprocator and a lower looper thread reciprocator respectively shifting the needle thread, the upper looper thread and the lower looper thread in thread paths respectively expanding between the opened needle thread upstream gripper and the closed needle thread downstream gripper, between the opened upper looper thread upstream gripper and the closed upper looper thread downstream gripper and between the opened lower looper thread upstream gripper and the closed lower looper thread downstream gripper at a time of feeding the cloth as a thread quantity respectively necessary for one stitch of the stitch forming device, and releasing the needle thread, the upper looper thread and the lower looper thread at a time of forming the stitch; a needle thread shifter, an upper looper thread shifter and a lower looper thread shifter for respectively adjusting a shift quantity shifted by the needle thread reciprocator, the upper looper thread reciprocator and the lower looper thread reciprocator of the thread path in correspondence to a thread quantity necessary for one stitch which changes in response to a stitch width for performing the stitch forming to the cloth, stitch length and/or a cloth thickness by a pressure foot; and a change-over means for respectively displacing the upper looper thread shifter and the lower looper thread shifter in such a manner that at a time of a narrow hem sewing, a shifting quantity of the upper looper thread necessary for one stitch becomes an equal quantity to a shifting quantity of the lower thread necessary for one stitch and at a time of a rolled hem sewing, the shifting quantity of the upper looper thread necessary for one stitch is increased and the shifting quantity of the lower looper thread is decreased.

Still further, in accordance with the present invention, there

is provided a thread feeding apparatus for a sewing machine which feeds a thread to a stitch forming device for stitch forming on a cloth, said thread feeding apparatus comprising: an upstream gripper for gripping the thread fed from a thread spool, said upstream gripper comprising a pair of grip plates biased together by a compression spring, said upstream gripper being closed by said stitch forming device at a time of forming the stitch and opened at a time of feeding of the cloth; a downstream gripper for gripping the thread introduced from said upstream gripper and comprising a pair of grip plates biased together by a compression spring, said downstream gripper being open at the time of forming the stitch to allow the thread to be pulled by said stitch forming device and being closed at the time of feeding of the cloth; and a reciprocator synchronously driven with said stitch forming device to shift the thread from a thread path extending between said open upstream gripper and said closed downstream gripper at the time of feeding of the cloth to provide a thread quantity necessary for one stitch and to release the thread at the time of forming the stitch; said reciprocator being disposed between a pair of thread guides arranged between said upstream gripper and said downstream gripper and spaced in direction of feed of the thread.

In the above described sewing machine, at a time of feeding a cloth, since the upstream gripper is opened together with the stitch forming device in an interlocking manner and the downstream gripper is closed, during this period, the reciprocator shifts the thread of the thread path expanding between the upstream gripper and the downstream gripper, thereby securing the thread quantity necessary for a stitch of the stitch forming device. Further, at a time of a stitch forming, since the upstream gripper is closed together with the stitch forming device in an interlocking manner and the downstream gripper is opened, during this period, the reciprocator releases the thread of the thread

path expanding between the upstream gripper and the downstream gripper, thereby feeding the thread quantity necessary for a stitch of the stitch forming device.

In this case, in order to correspond to the thread quantity necessary for one stitch which changes in response to a stitch width for performing the stitch forming to the cloth, stitch length and/or a cloth thickness by a pressure foot, the shifter can adjust the shift quantity shifted by the reciprocator.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view which schematically shows an overlock sewing machine to which a thread feeding apparatus for an overlock sewing machine in accordance with the present invention is applied;

Fig. 2 is a perspective view which shows a mechanism for driving an upper looper and a lower looper of the overlock sewing machine in Fig. 1;

Fig. 3 is a perspective view which shows a mechanism of an adjusting portion for a stitch feeding in the overlock sewing machine of Fig. 1;

Fig. 4 is an exploded perspective view which shows a mechanism of an adjusting portion for a stitch width in the overlock sewing machine of Fig. 1;

Fig. 5 is a perspective view which schematically shows an overlock sewing machine to which a thread feeding apparatus for an overlock sewing machine in accordance with the present invention is applied;

Fig. 6 is a perspective view which shows a thread feeding

apparatus for an overlock sewing machine in accordance with the present invention;

Fig. 7 is an exploded perspective view which shows an upstream gripper and a driving portion for a thread feeding of a thread feeding apparatus for an overlock sewing machine in accordance with the present invention;

Figs. 8(a) and 8(b) are cross-sectional views which show an upstream gripper and a downstream gripper of a thread feeding apparatus for an overlock sewing machine in accordance with the present invention, in which Fig. 8(a) shows an opened state and Fig. 8(b) shows a closed state;

Fig. 9 is an exploded perspective view which shows a downstream gripper of a thread feeding apparatus for an overlock sewing machine in accordance with the present invention;

Fig. 10 is an exploded perspective view which shows a reciprocator and a shifter of a thread feeding apparatus for an overlock sewing machine in accordance with the present invention;

Fig. 11 is an explanatory view which shows a relation between a reciprocator of a thread feeding apparatus for an overlock sewing machine in accordance with the present invention and a reciprocator driving cam of a driving portion for a thread feeding;

Fig. 12 is an exploded perspective view which shows a stitch changeover means of a thread feeding apparatus for an overlock sewing machine in accordance with the present invention;

Fig. 13 is an exploded perspective view which shows an adjustment

means for slightly adjusting a thread tension of a thread feeding apparatus for an overlock sewing machine in accordance with the present invention;

Fig. 14 is an explanatory view which shows a moved position of each of a needle thread shifter, an upper looper thread shifter and a lower looper thread shifter in the case that a double needles overlock sewing is selected by a stitch changeover means of a thread feeding apparatus for an overlock sewing machine in accordance with the present invention;

Fig. 15 is an explanatory view which shows a moved position of each of a needle thread shifter, an upper looper thread shifter and a lower looper thread shifter in the case that a single needle overlock sewing is selected by a stitch changeover means of a thread feeding apparatus for an overlock sewing machine in accordance with the present invention;

Fig. 16 is an explanatory view which shows a moved position of each of a needle thread shifter, an upper looper thread shifter and a lower looper thread shifter in the case that a narrow hem sewing is selected by a stitch changeover means of a thread feeding apparatus for an overlock sewing machine in accordance with the present invention;

Fig. 17 is an explanatory view which shows a moved position of each of a needle thread shifter, an upper looper thread shifter and a lower looper thread shifter in the case that a rolled hem sewing is selected by a stitch changeover means of a thread feeding apparatus

for an overlock sewing machine in accordance with the present invention;

Figs. 18(a), 18(b), 18(c) and 18(d) are views which show disposition of a thread feeding unit base plate, a reciprocator, a shifter and a thread feeding unit front plate in the case that a needle is positioned in an upper dead center, in which Fig. 18(a) shows a disposition in a double needles overlock sewing, Fig. 18(b) shows a disposition in a single needle overlock sewing, Fig. 18(c) shows a disposition in a narrow hem sewing and Fig. 18(d) shows a disposition in a rolled hem sewing;

Fig. 19 is an explanatory view which shows a stitch of a double needles overlock sewing by the overlock sewing machine shown in Fig. 1;

Fig. 20 is an explanatory view which shows a stitch of a single needle overlock sewing by the overlock sewing machine shown in Fig. 1;

Fig. 21 is an explanatory view which shows a stitch of a narrow hem sewing by the overlock sewing machine shown in Fig. 1;

Fig. 22 is an explanatory view which shows a stitch of a rolled hem sewing by the overlock sewing machine shown in Fig. 1; and

Fig. 23 is a perspective view which schematically shows a state that a cloth thickness adjusting and interlocking means is applied to an overlock sewing machine in accordance with the present invention.

An embodiment of a thread feeding apparatus for a sewing machine in accordance with the present invention will be explained below with reference to the accompanying drawings in a state of assembled in an overlock sewing machine having double needles and four threads.

The overlock sewing machine having double needles and four threads is structured, as shown in Fig. 1, such that a driving shaft 3 fixed to a hand wheel 2 is axially supported to a machine casing 1. The hand wheel 2 is rotated by a motor M through a timing belt B.

The drive shaft 3 is provided with a needle driving eccentric cam 4 (referring to Fig. 2) and a lower end portion of a needle driving rod 5 (referring to Fig. 2) serving as a cam follower is pivotally attached to the needle driving eccentric cam 4. Further, the other end of the needle driving rod 5 is pivotally attached to a needle driving arm 6 pivotally supported by the machine casing 1. A needle clamp link 7 is pivotally supported to a U-shaped front end portion 6a of the needle driving arm 6 by a connecting pin 10. The needle clamp link 7 is pivotally attached to a needle clamp body 8, which is slidably mounted to a guide rod 11 fixed to the machine casing 1, by a connecting pin 12. A left needle 9A and a right needle 9B are fixed to the needle clamp body 8.

Further, a lower looper driving inclined cam 13 and a upper looper driving inclined cam 14 are fixed to the drive shaft 3 as shown in Fig. 2, and rollers 17 and 18 which correspond to cam followers respectively mounted to a lower looper driving fork 15 and an upper looper driving fork 16 are engaged with the lower looper driving

inclined cam 13 and the upper looper driving inclined cam 14. The lower looper driving fork 15 is pivotally attached to a lower looper drive shaft 19 by a pin 20. A lower looper 21 is fixed to the lower looper drive shaft 19. The upper looper driving fork 16 is pivotally attached to a upper looper drive shaft 22 by a pin 23. An end of an upper looper drive arm 24 is fixed to the upper looper drive shaft 22 and an upper looper mounting shaft 25 is pivotally attached to the other end of the upper looper drive arm 24. The upper looper mounting shaft 25 is axially supported to a pivot 26 rotatably mounted to the machine casing 1 in a slidable manner. An upper looper 27 is fixed to an upper end of the upper looper mounting shaft 25.

Still further, as shown in Fig. 3, a horizontal feeding cam 910 corresponding to a part of a stitch feed adjusting portion 900 is fixed to the drive shaft 3. The stitch feed adjusting portion 900 is fixed to a main feed gear mounting shaft 903 and a sub feed gear mounting shaft 904 in such a manner that a main feed gear 901 and a sub feed gear 902 respectively move in front and in the rear in a cloth feeding direction, and the main feed gear mounting shaft 903 and the sub feed gear mounting shaft 904 are slidably supported to two support portions 905a and 905b of a feed base plate 905. A main feed drive body 906 and a sub feed drive body 907 are fitted to the main feed gear mounting shaft 903 and the sub feed gear mounting shaft 904, and the main feed gear mounting shaft 903 is fixed to the main feed drive body 906 and is slidable with respect to the sub feed drive body 907. Similarly, the sub feed gear mounting shaft 904 is fixed to the sub feed drive

body 907 and is slidable with respect to the main feed drive body 906. The feed base plate 905 supporting these members has a cylindrical boss portion 905c and is supported to a base plate shaft 908 by this boss portion 905c. The base plate shaft 908 is pivotally supported to the machine casing 1.

On the contrary, a horizontal feeding rod 911 is fitted to the horizontal feeding cam 910 fixed to the drive shaft 3. An end of the horizontal feeding rod 911 is connected to an end 912a of a main feeding drive arm 912 and a main feeding slide rod 913 is slidably supported to a rectangular hole 912b of the main feeding drive arm 912 in such a manner as to be held between two stop plates 914A and 914B. The main feeding slide rod 913 is supported to the feed base plate 905 at a portion close to the cylindrical boss portion 905c by a swing shaft (not shown). The other end 912c of the main feeding drive arm 912 is connected to the main feeding drive body 906 fixed to the main feeding gear mounting shaft 903 through a main feeding link 916.

Further, a sub feeding slide rod 918 is supported to the feeding base plate 905 by a swing shaft 915 at a side opposite to a side to which the main feeding drive arm 912 is mounted and the sub feeding slide rod 918 is slidably supported within two rectangular holes 917a of a sub feeding drive arm 917 in such a manner as to be held between two stop plates (not shown). A connecting rod 920 which transmits a swing motion of the main feeding slide rod 913 and the main feeding drive arm 912 is connected to the sub feeding drive arm 917. The connecting rod 920 is connected to the main feeding drive body 906.

On the contrary, one end 917b of the sub feeding drive arm 917 is connected to the sub feeding drive body 907 fixed to the sub feed gear mounting shaft 904 through a sub feeding link 921.

The stitch feed adjusting portion 900 structure in the above manner is provided with a feed quantity adjusting dial 930 for adjusting a main feeding. The feed quantity adjusting dial 930 is fixed to a substantially half circular plate 931 through a feed dial shaft 936 and the substantially half circular plate 931 is connected to an adjusting arm 934 through a link 932 and an adjusting plate 933. The adjusting arm 934 is axially supported to the base plate shaft 908 and an arm portion 934a is connected to the one end 912a of the main feeding drive arm 912 through an adjusting link 935. Further, a stitch feed adjusting arm 421 of a thread tension slightly adjusting means 400 mentioned after is fixed to the adjusting arm 934 by a fixing screw 422. Still further, a differential adjusting lever 940 (referring to Fig. 1) is provided for adjusting a sub feed. The differential adjusting lever 940 is connected to the other end 917c of the sub feeding drive arm 917 through the base plate shaft, the sub feeding drive arm and the like.

The main feed gear 901 and the sub feed gear 902 of the stitch feed adjusting portion 900 can move a cloth pressed to a needle plate 937 (referring to Fig. 1) by a pressure foot 1050 fixed to a front end of a push rod 1051 slidably mounted to the machine casing 1 at a suitable cloth feed amount.

Further, an overlock sewing machine having double needles and

four threads has a stitch width adjusting portion 800 as shown in Fig. 4, for changing a cloth cut width (a knife cut width) by a knife drive mechanism 36 for cutting an edge of the cloth to an even length immediately before sewing. The stitch width adjusting portion 800 is structured such that a stitch width adjusting dial 802 is screwed to a shaft 801 fixed to the machine casing 1 and a lower knife base plate 803 is axially supported by the stitch width adjusting dial 802. In this case, a rotational motion of the lower knife base plate 803 is restricted by a rotation stop shaft 804 fixed to the machine casing 1.

A stitch forming is performed onto the cloth by the left needle 9A, the right needle 9B, an upper looper 27 and the lower looper 21 of a stitch forming device 100 for an overlock sewing machine structure in the above manner. A thread feeding apparatus is used for feeding each of threads to the left needle 9A, the right needle 9B, the upper looper 27 and the lower looper 21 of the stitch forming device 100.

The thread feeding apparatus is provided with a left needle thread upstream gripper 40, a right needle thread upstream gripper 41, an upper looper thread upstream gripper 50 and a lower looper thread upstream gripper 60 (referring to Figs. 1 and 6) which grip a left needle thread 31, a right needle thread 32, an upper looper thread 33 and a lower looper thread 34 respectively fed from bobbins 51, 52, 53 and 54 and which are closed by the stitch forming device 100 at a time of a stitch forming and is opened at a time of a cloth feeding, as shown in Fig. 5.

The left needle thread upstream gripper 40, the right needle

thread upstream gripper 41, the upper looper thread upstream gripper 50 and the lower looper thread upstream gripper 60 is provided with a pair of grip plates 44, compression spring receivers 45, compression springs 46, thrust receivers 47 and spring receivers 48 on upper gripper shafts 42 pivotally attached to five upstream gripper supporting plate 43, respectively fixedly attached to a thread feeding unit substrate 501 fixed to the machine casing 1, as shown in Figs. 1, 6, 7 and 8.

The pair of grip plates 44, compression spring receivers 45, compression springs 46, thrust receivers 47 and spring receivers 48 are respectively provided between the upstream gripper supporting plates 43 as a set. Concretely speaking, the compression spring 46 is disposed between the compression spring receiver 45 and the spring receiver 48 axially attached to the upstream gripper 42. Further, the thrust receiver 47 is screwed to the upstream gripper 42 between the pair of grip plate 44 and the compression spring receiver 45. The thrust receiver 47 is provided for the purpose of stopping the pair of grip plate 44 to a predetermined position through the compression spring receiver 45 in order to release the left needle thread 31, the right needle thread 32, the upper looper thread 33 and the lower looper thread 34 at a time of a cloth feeding.

Further, the thread feeding apparatus is provided with a left needle thread downstream gripper 70, a right needle thread downstream gripper 71, an upper looper thread downstream gripper 80 and a lower looper thread downstream gripper 90 which grip the left needle thread 31, the right needle thread 32, the upper looper thread 33 and the lower

looper thread 34 respectively introduced from the left needle thread upstream gripper 40, the right needle thread upstream gripper 41, the upper looper thread upstream gripper 50 and the lower looper thread upstream gripper 60 and which is opened at a time of a stitch forming so that the left needle thread 31, the right needle thread 32, the upper looper thread 33 and the lower looper thread 34 is pulled out by the stitch forming device 100 and is closed at a time of a cloth feeding.

The left needle thread downstream gripper 70, the right needle thread downstream gripper 71, the upper looper thread downstream gripper 80 and the lower looper thread downstream gripper 90 are provided in a thread feeding unit front plate 502 fixed to the thread feeding unit base plate 501 fixed to the machine casing 1 by a connecting screw 510 respectively through a shifter supporting shaft 511 and a spacer 512, a reciprocator supporting shaft 508A and a spacer 509A, a reciprocator supporting shaft 508B and a spacer 509B, and a shifter supporting shaft 521 and a spacer 522, as respectively shown in Figs. 1, 6, 8, 9 and 10. The left needle thread downstream gripper 70, the right needle thread downstream gripper 71, the upper looper thread downstream gripper 80 and the lower looper thread downstream gripper 90 include a downstream grip shaft 72 pivotally attached to five downstream gripper supporting plates 73 fixedly attached to the thread feeding unit front plate 502, respectively and the pair of grip plates 44, compression spring receivers 45, compression springs 46, thrust receivers 47 and spring receivers 48 provided onto the downstream grip shaft 72.

The pair of grip plates 44, compression spring receivers 45, compression springs 46, thrust receivers 47 and spring receivers 48 are respectively provided between the downstream gripper supporting plates 73 as a set. Concretely speaking, the compression spring 46 is disposed between the compression spring receiver 45 and the spring receiver 48 axially attached to the downstream grip shaft 72. Further, the thrust receiver 47 is screwed to the downstream gripper 72 between the pair of grip plate 44 and the compression spring receiver 45. The thrust receiver 47 is provided for the purpose of stopping the pair of grip plate 44 to a predetermined position through the compression spring receiver 45 in order to release the left needle thread 31, the right needle thread 32, the upper looper thread 33 and the lower looper thread 34 at a time of a stitch forming.

Further, the thread feeding apparatus is provided with a thread feed drive portion 300 which closes the left needle thread upstream gripper 40, the right needle thread upstream gripper 41, the upper looper thread upstream gripper 50 and the lower looper thread upstream gripper 60 at a time of a stitch forming and opens at a time of a cloth feeding and which opens the left needle thread downstream gripper 70, the right needle thread downstream gripper 71, the upper looper thread downstream gripper 80 and the lower looper thread downstream gripper 90 at a time of a stitch forming and closes at a time of a cloth feeding, as shown in Figs. 6, 7 and 9. The thread feed drive portion 300 transmits a rotation of a thread feed drive portion pulley 301 fixedly attached to the drive shaft 3 to the left needle thread upstream gripper

40, the right needle thread upstream gripper 41, the upper looper thread upstream gripper 50, the lower looper thread upstream gripper 60, the left needle thread downstream gripper 70, the right needle thread downstream gripper 71, the upper looper thread downstream gripper 80 and the lower looper thread downstream gripper 90 through a timing belt 303 (referring to Fig. 1).

The above thread feed drive portion 300 is structured such that a thread feed drive shaft pulley 302 around which the timing belt 303 for transmitting a rotation of the thread feed drive portion pulley 301 is wound is fixedly attached to an end of a thread feed drive shaft 304 axially supported to a thread feed drive shaft receiver 305 fixed to the thread feed unit base plate 501, and a thread grip drive cam 307 forming a front cam is fixedly attached to the other end of the thread feed drive shaft 304. The front cam of the thread grip drive cam 307 is formed such as to close the left needle thread upstream gripper 40, the right needle thread upstream gripper 41, the upper looper thread upstream gripper 50 and the lower looper thread upstream gripper 60 at a time of a stitch forming so as to grip the left needle thread 31, the right needle thread 32, the upper looper thread 33 and the lower looper thread 34 and to open at a time of a cloth feeding in a synchronous manner with the stitch forming device 100.

In order to respectively close and open the left needle thread upstream gripper 40, the right needle thread upstream gripper 41, the upper looper thread upstream gripper 50, the lower looper thread upstream gripper 60, the left needle thread downstream gripper 70, the

right needle thread downstream gripper 71, the upper looper downstream gripper 80, the lower looper thread downstream gripper 90, the thread feed drive portion 300 has a gripper open and close drive mechanism 300A. The gripper open and close drive mechanism 300A is provided with a downstream gripper drive arm 310 and an upstream gripper open arm 311 to which a cam followers 308 operated by the front cam of the thread grip drive cam 307 are axially attached by a shaft 309, respectively. The downstream gripper drive arm 310 and the upstream gripper open arm 311 are fixed to an end of a gripper drive shaft 312 which is axially supported by a gripper drive shaft receiver 313 held between the thread feed unit base plate 501 and the thread feed unit front plate 502, and a downstream gripper open arm 314 is fixed by fixing pin 315 to the other end of the gripper drive shaft 312.

In the gripper open and close drive mechanism 300A, the upstream gripper open arm 311 can lift up an end of the upstream grip shaft 42 by rotation of the thread grip drive cam 307 and the downstream gripper open arm 314 can lift up an end of the downstream grip shaft 72 through the downstream gripper drive arm 310, respectively.

Further, the thread feeding apparatus is driven in a synchronous manner with the left needle 9A, the right needle 9B, the upper looper 27 and the lower looper 21, respectively as shown in Fig. 10, and is provided with a pair of reciprocators 503 and 504 which shift the left needle thread 31, the right needle thread 32, the upper looper thread 33 and the lower looper thread 34 of the thread paths respectively expanding between the left needle thread upstream gripper 40, the right

needle thread upstream gripper 41, the upper looper thread upstream gripper 50 and the lower looper thread upstream gripper 60 which are opened at a time of a cloth feeding, and the left needle thread downstream gripper 70, the right needle thread downstream gripper 71, the upper looper thread downstream gripper 80 and the lower looper downstream gripper 90 which are closed as thread quantities respectively necessary for one stitch of the stitch forming device 100, and release the left needle thread 31, the right needle thread 32, the upper looper thread 33 and the lower looper thread 34 at a time of a stitch forming.

The pair of reciprocators 503 and 504 is provided with left needle thread reciprocators 503a and 504a, right needle thread reciprocators 503b and 504b, upper looper thread reciprocators 503c and 504c and lower looper reciprocators 503d and 504d respectively corresponding to the left needle thread 31, the right needle thread 32, the upper looper thread 33 and the lower looper thread 34. The left needle thread reciprocators 503a and 504a, the right needle thread reciprocators 503b and 504b, the upper looper thread reciprocators 503c and 504c and the lower looper reciprocators 503d and 504d include inclined portions SS which respectively introduce the left needle thread 31, the right needle thread 32, the upper looper thread 33 and the lower looper thread 34 from each of inlet ports E to a thread path point S aligned to each pair of thread guide G1 and G2 formed on the thread feed unit base plate 501 and the thread feed unit front plate 502.

The pair of reciprocators 503 and 504 are disposed between the thread feed unit base plate 501 and the thread feed unit front plate 502 which are separately disposed between the left needle thread upstream gripper 40, the right needle thread upstream gripper 41, the upper looper thread upstream gripper 50 and the lower looper thread upstream gripper 60, and the left needle thread downstream gripper 70, the right needle thread downstream gripper 71, the upper looper thread downstream gripper 80 and the lower looper thread downstream gripper 90, respectively in a thread feeding direction. Concretely speaking, the pair of reciprocators 503 and 504 are connected by a male screw portion formed on one end of a reciprocator drive shaft 505 and a nut 507 through a spacer 506 and the pair of connected reciprocators 503 and 504 are reciprocally supported by the reciprocator supporting shafts 508A and 508B fixed between the thread feed unit base plate 501 and the thread feed unit front plate 502. Further, a cam follower 525 is fixed to the other end of the reciprocator drive shaft 505, and the cam follower 525 projects from a hole 501b formed on the thread feed unit base plate 501 so as to engage with a groove 306a of a reciprocator drive cam 306 fixedly attached to the thread feed drive shaft 304 (referring to Figs. 7 and 11). The groove 306a of the reciprocator drive cam 306 is formed as a recess shape so as to reciprocate the pair of reciprocators 503 and 504 through the reciprocator drive shaft 505 by a rotation of the thread feed drive shaft 304.

Further, the thread feeding apparatus has, as shown in Fig. 10, a needle thread shifter 514, an upper looper thread shifter 530 and

a lower looper thread shifter 531 which respectively adjust each of shift quantities shifted to a direction perpendicular to a thread feeding direction by the pair of reciprocators 503 and 504 of the thread path in correspondence to each of the thread quantities necessary for one stitch changing in response to a stitch width and a stitch length for performing a stitch forming onto the cloth.

The needle thread shifter 514, the upper looper thread shifter 530 and the lower looper thread shifter 531 are disposed between the pair of reciprocators 503 and 504. The needle thread shifter 514 is provided with thread grooves 514b and 514c for introducing the left needle thread 31 and the right needle thread 32 and is supported by the one reciprocator supporting shaft 508A and the shifter supporting shaft 511 fixed between the thread feed unit base plate 501 and the thread feed unit front plate 502 in a such manner as to move in a direction perpendicular to a thread feeding direction. Further, a hole 514a is formed on an end of the needle thread shifter 514 and further a needle thread shifter drive shaft 520a provided on an end of a stitch feed adjust and shift lever 520 axially attached to the thread feed unit base plate 501 by a stepped screw 519 in a projecting manner is inserted into the one end of the needle thread shifter 514. The stitch feed adjust and shift lever 520 is provided with a spring hook 520b in a projecting manner, and a tensional spring 518 is in a tensional manner provided between the spring hook 520b and the pin 501a provided on the thread feed unit base plate 501 in a projecting manner. Still further, an end of a connecting link 517 is axially attached to the

stitch feed adjust and shift lever 520 by a caulking stepped pin 516 and the other end of the connecting link 517 is axially attached to a shift adjusting plate 513 by a caulking stepped pin 515. The shift adjusting plate 513 is supported by the shifter supporting shaft 511 ad the one reciprocator supporting shaft 508A in such a manner as to move to a direction perpendicular to a thread feeding direction.

Accordingly, since the stitch feed adjust and shift lever 520 is always elastically-forced in such a manner as to be rotated to a clockwise direction as seen from a sewing operator, the needle thread shifter 514 and the shift adjusting plate 513 are going to be horizontally elastically-forced to a rightward direction.

The upper looper thread shifter 530 and the lower looper thread shifter 531 are respectively provided with thread grooves 530d and 531c for introducing the upper looper thread 33 and the lower looper thread 34 and is supported by the other reciprocator supporting shaft 508B and the shifter supporting shaft 521 fixed between the thread feed unit base plate 501 and the thread feed unit front plate 502 in such a manner as to move in a direction perpendicular to a thread feeding direction. A first spring hook 530a is provided in one end of the upper looper thread shifter 530 in a projecting manner, and a tension spring 533 is provided between the first spring hook 530a and a spring hook 502a projectingly provided on an end of the thread feed unit front plate 502 in a tensioning manner. Accordingly, the upper looper thread shifter 530 is elastically forced rightward in a horizontal direction as seen from the thread feed unit front plate 502. A second spring hook

530b is provided in the other end of the upper looper thread shifter 530 in a projecting manner, and a tension spring 532 is provided between the second spring hook 530b and a spring hook 531a projectingly provided on an end of the lower looper thread shifter 531 in a tensioning manner. Accordingly, the lower looper thread shifter 531 is elastically forced leftward in a horizontal direction as seen from the thread feed unit front plate 502.

The thread feeding apparatus is provided with a stitch changeover means 500 corresponding to a changeover means which displaces the upper looper thread shifter 530 and the lower looper thread shifter 531 in such a manner as to substantially equalize a shift quantity of the upper looper thread 33 necessary for a stitch to a shift quantity of the lower looper thread 34 necessary for a stitch at a time of a narrow hem sewing, and to increase a shift quantity of the upper looper thread 33 necessary for a stitch and decrease a shift quantity of the lower looper thread 34 at a time of a rolled hem sewing (Fig. 1).

The stitch changeover means 500 can change over a sewing mode among the narrow hem sewing, the rolled hem sewing, the single needle overlock sewing and the double needles overlock sewing by rotating a stitch selecting dial 560 so as to horizontally move a stitch changeover cam plate 550. The stitch changeover cam plate 550 is provided with a narrow hem changeover cam 550a for changing over to the narrow hem sewing and the rolled hem sewing and a looper thread adjusting cam 550b for changing over to the single needle overlock sewing and the double

needles overlock sewing, and is supported in two stitch changeover cam plate supporting shaft 551A and 551B fixed to the thread feed unit base plate 501 in such a manner as to move in a horizontal direction.

An end of a looper thread adjusting arm 552 is axially attached to the one of the stitch changeover cam plate supporting shaft 551A and the other end of the looper adjusting arm 552 is axially attached to a looper thread adjusting cam follower 553 which is engaged with the looper thread adjusting cam 550b of the stitch changeover cam plate 550. Further, an end of a looper thread adjusting link 554 is axially attached to the looper thread adjusting cam follower 553, and a pulley shaft 554a provided on the other end of the looper thread adjusting link 554 in a projecting manner is engaged with a cam groove 513a (referring to Fig. 10) provided on the shift adjust plate 513.

An end of a narrow hem changeover arm 557 is axially attached to the other of the stitch changeover cam plate supporting shaft 551B and the other end of the narrow hem changeover arm 557 is axially attached to a narrow hem cam follower 556 which is engaged with the looper thread adjusting cam 550a of the stitch changeover cam plate 550. Further, an end of a narrow hem changeover link 558 is axially attached to the narrow hem cam follower 556, and a narrow hem changeover piece 558a provided on the other end of the narrow hem changeover link 558 in a projecting manner is engaged with a end surface cam 530c and 531b (referring to Fig. 10) respectively formed on the upper looper thread shifter 530 and the lower looper thread shifter 531. The end surface cams 530c and 531b are structured such that when the narrow

hem changeover piece 558a ascends, an inlet port 530d of the upper looper thread shifter 530 and an inlet port of the lower looper thread shifter 531 (referring to Fig. 10) are apart from each other.

The stitch selecting dial 560 is fixed to an end of a stitch selecting dial shaft 561 axially supported to a stitch selecting dial support plate 567 fixed to the machine casing 1, the other end of the stitch selecting dial shaft 561 is fixed to a stitch selecting arm 562, a front end of the stitch selecting arm 562 is axially attached to an end of a connecting link 564 and the other end of the connecting link 564 is axially attached by caulking stopped pin 563 to an end of the stitch changeover cam plate 550 by a caulking pin 565.

The thread feeding apparatus having the above structure includes the thread tension slightly adjusting means 400 shown in Figs. 4, 10, 13 and 14 for in an interlocking manner driving the upper looper thread shifter 530 and the lower looper thread shifter 531 in correspondence to a stitch quantity necessary for a stitch which changes in response to an operation of the stitch width adjust dial 802 of the stitch width adjust portion 800 (referring to Fig. 1). The thread tension slightly adjusting means 400 is structured such as to connect the lower knife base plate 803 of the stitch width adjust portion 800 to a wire hook 530e provided on the upper looper thread shifter 530 in a projecting manner by a stitch width adjust and interlock wire 410 and further to connect a wire hook 421a (referring to Fig. 3) projectingly provided on the stitch feed adjusting arm 421 fixed to the adjust arm 934 of the stitch feed adjusting portion 900 to a wire hook 520c of the stitch

feed adjusting shift lever 520 by a stitch feed adjust and interlock wire 420.

The stitch width adjust and interlock wire 410 is wound around a pulley 412, a pulley 404A, a pulley 424A and a pulley 555 so as to be introduced to the upper looper thread shifter 530 from the lower knife base plate 803, and the stitch feed adjust and interlock wire 420 is wound around a pulley 404B, a pulley 424B and a pulley 524 so as to be introduced to the stitch feed adjust and shift lever 520 from the stitch feed adjust arm 421, respectively. The pulley 412 is rotatably fixed to the machine casing 1 at a position close to the stitch width adjust portion 800 by a shaft 411, and the pulleys 424A and 424B are rotatably fixed to a shaft provided in a projecting manner to an intermediate pulley plate 423 fixed near a center position of the machine casing 1, respectively. The pulleys 404A and 404B are rotatably fixed to slightly adjusting pulley shafts 403A and 403B, and the slightly adjusting pulley shafts 403A and 403B are mounted to an oval hole formed on a thread tension slightly adjusting plate 401 fixed by fixing pin 409 to the machine casing 1 at a position close to the stitch feed adjust portion 900 by using a mounting seat of stitch width slightly adjusting plates 402A and 402B. The stitch width slightly adjusting plates 402A and 402B are respectively mounted to the thread tension slightly adjusting plate 401 by a stitch width slightly adjusting screw 406 in such a manner as to move, and a compression spring 405 is disposed between the stitch width slightly adjusting plates 402A and 402B and the thread tension slightly adjusting plate 401 so as to always elastically-force the

stitch width slightly adjusting plates 402A and 402B to a predetermined direction. Accordingly, a fixed position of the pulleys 404A and 404B can be changed by the stitch width slightly adjusting screw 406.

Further, the pulley 555 is rotatably fixed to the pulley shaft 554a projectingly provided on the looper thread adjust link 554 of the stitch changeover means 500 projecting from the cam shaft 513a of the shift adjust plate 513, and the pulley 524 is rotatably fixed to the pulley shaft 523 projectingly provided on the thread feed unit 501, respectively.

Next, an operation of the thread feeding apparatus having the above structure will be explained below. In the explanation of the operation, directions in the description correspond to those as seen from an operator of the sewing machine.

At first, the left needle thread 31, the right needle thread 32, the upper looper thread 33 and the lower looper thread 34 are respectively pulled from the respective bobbins 51, 52, 53 and 54 for the left needle thread, the right needle thread, the upper looper thread and the lower looper thread, and they are respectively inserted through a thread guide 37 (referring to Fig. 5) between the respective pair of grip plates 44 of the left needle thread upstream gripper 40, the right needle thread upstream gripper 41, the upper looper thread upstream gripper 50 and the lower looper upstream gripper 60, into the thread guide G1 in correspondence to the respective thread of the thread feed unit base plate 501, the respective inlet port E of the reciprocator 503, the respective inlet ports 514b and 514c of the needle thread

shifter 514, the inlet port 530d of the upper looper thread shifter 530, the inlet port 531c of the lower looper thread shifter 531, the respective inlet ports E of the reciprocator 504, the thread guide G2 in correspondence to the respective thread of the thread feed unit front plate 502 and the left needle thread downstream gripper 70, the right needle thread downstream gripper 71, the upper looper thread downstream gripper 80 and between the respective pair of grip plates 44 of the lower looper thread downstream gripper 90. After insertion, the left needle thread 31 is passed to a needle hole of the left needle 9A through the thread guide 28 and a needle thread balance 29, the right needle thread 32 is passed to a needle hole of the left needle 9B through the thread guide 28 and a needle thread balance 29 and the upper looper thread 33 and the lower looper thread 34 are passed to thread inlet ports of the upper looper 27 and the lower looper 21 through a threader 35 for automatically guiding the thread by using a pressurized gas, respectively.

As mentioned above, when a sewing operation is started after completion of threading, the drive shaft 3 is rotated and the needle drive arm 6 performs a reciprocating swing motion by the needle drive rod 5 pivotally attached to the needle drive eccentric cam 4 provided on the drive shaft 3 in every one rotation of the drive shaft 3 so that the right needle 9A and the left needle 9B perform a reciprocating vertical motion. At that time, the thread feed drive portion pulley 301 rotates the thread grip drive cam 307 through the timing belt 303, the thread feed drive shaft pulley 302 and the thread feed drive shaft

304. During a rotation of the thread grip drive cam 307, the upstream gripper open arm 311 and the downstream gripper open arm 312 alternately perform a swing motion by a front cam of the thread grip drive cam 307. Accordingly, the upstream grip shaft 42 and the downstream grip shaft 72 perform a reciprocating motion while alternately moving in the rightward direction by the upper gripper open arm 311 and the downward gripper open arm 312, thereby closing the left needle thread upstream gripper 40, the right needle thread upstream gripper 41, the upper looper thread upstream gripper 50 and the lower looper upstream gripper 60 at a time of a stitch forming and opening them at a time of a cloth feeding, and opening the left needle thread downstream gripper 70, the right needle thread downstream gripper 71, the upper looper thread downstream gripper 80 and the lower looper downstream gripper 90 at a time of a stitch forming and closing them at a time of a cloth feeding.

At the same time of operation for opening and closing the respective threads of the grippers, the reciprocators 503 and 504 interlocking with the cam follower 525 fitted into the groove 306a of the reciprocator drive cam 306 fixed to the drive shaft 3 perform a reciprocating motion to a direction perpendicular to a thread feeding direction in every one rotation of the drive shaft 3. At that time, the left needle thread 31, the right needle thread 32, the upper looper thread 33 and the lower looper thread 34 are respectively introduced into the point of the thread path S aligning to the respective pair of thread guide G1 and G2 formed on the thread feed unit base plate 501 and the thread feed unit front plate 502 by the respective inclined

portions SS of the reciprocators 503 and 504. Due to the reciprocating motion of the reciprocators 503 and 504, the left needle thread 31, the right needle thread 32, the upper looper thread 33 and the lower looper thread 34 are shifted and released as a thread quantity for a stitch of the stitch forming device 100.

In this case, in the case that the double needles overlock sewing, the single needle overlock sewing, the narrow hem sewing and the rolled hem sewing should be respectively selected, the mode can be changed over by rotating the stitch selecting dial 560 of the stitch changeover means 500. For example, in the case that the double needles overlock sewing is selected by the stitch selecting dial 560, as shown in Fig. 14, since the stitch selecting cam 550 is positioned at a leftmost position, the looper thread adjust cam follower 553 engaging with the looper thread adjust cam 550b of the stitch changeover cam plate 550 ascends along the looper thread adjust cam 550b. When the looper thread adjust cam follower 553 ascends, the pulleys 555 ascends to an uppermost position of the cam groove 513a of the shift adjust plate 513 so that the stitch width adjust and interlock wire 410 is ascended, thereby displacing the upper looper thread shifter 530 on which the stitch width adjust and interlock wire 410 is hooked to the leftward direction. At this time, the lower looper thread shifter 531 is displaced leftward by a tensional force of the tension spring 532. Accordingly, the upper looper thread shifter 530 and the lower looper thread shifter 531, and the upper looper thread reciprocators 503c and 504c and the lower looper thread reciprocators 503d and 504d are

respectively disposed in positions having a relation in which a shift quantity of the upper looper thread 33 and the lower looper thread 34 is most in the case that the left needle 9A and the right needle 9B are positioned at an upper dead center, as shown in Fig. 18(a). This is because as shown in Fig. 19, a stitch width W of the upper looper thread 33 and the lower looper thread 34 is increased at a degree of a needle width WL in comparison with the cases of the single needle overlock sewing, the narrow hem sewing and the rolled hem sewing mentioned below.

Further, in the case that the single needle overlock sewing is selected by the stitch selecting dial 560, as shown in Fig. 15, since the stitch selecting cam 550 is moved to a position which is in a rightward position of the position in the case of the double needles overlock sewing, the looper thread adjust cam follower 553 engaging with the looper thread adjust cam 550b of the stitch changeover cam plate 550 descends along the looper thread adjust cam 550b. When the looper thread adjust cam follower 553 descends, the pulleys 555 descends to an intermediate position of the cam groove 513a of the shift adjust plate 513 so that the stitch width adjust and interlock wire 410 is descended, thereby displacing the upper looper thread shifter 530 on which the stitch width adjust and interlock wire 410 is hooked to the rightward direction by a tensional force of the tension spring 533. At this time, the lower looper thread shifter 531 is displaced rightward by a tensional force of the tension spring 532. Accordingly, the upper looper thread shifter 530 and the lower looper thread shifter

531, and the upper looper thread reciprocators 503c and 504c and the lower looper thread reciprocators 503d and 504d are respectively disposed in positions having a relation in which a shift quantity of the upper looper thread 33 and the lower looper thread 34 is reduced in comparison with the case of the double needles overlock sewing in the case that the left needle 9A and the right needle 9B are positioned at an upper dead center, as shown in Fig. 18(b). This is because as shown in Fig. 20, the stitch width W of the upper looper thread 33 and the lower looper thread 34 is decreased at a degree of a needle width WL in comparison with the cases of the double needles overlock sewing.

Still further, in the case that the narrow hem sewing is selected by the stitch selecting dial 560, as shown in Fig. 16, since the stitch selecting cam 550 is moved to a position which is in a rightward position of the position in the case of the single needle overlock sewing, the looper thread adjust cam follower 553 engaging with the looper thread adjust cam 550b of the stitch changeover cam plate 550 moves to the lowermost position along the looper thread adjust cam 550b. When the looper thread adjust cam follower 553 descends to the lowermost position, the pulleys 555 descends to the lowermost position of the cam groove 513a of the shift adjust plate 513 so that the stitch width adjust and interlock wire 410 is descended, thereby displacing the upper looper thread shifter 530 on which the stitch width adjust and interlock wire 410 is hooked to the rightward direction by a tensional force of the tension spring 533. At this time, the lower looper thread shifter 531 is displaced rightward by a tensional force of the tension

spring 532. Accordingly, the upper looper thread shifter 530 and the lower looper thread shifter 531, and the upper looper thread reciprocators 503c and 504c and the lower looper thread reciprocators 503d and 504d are respectively disposed in positions having a relation in which a shift quantity of the upper looper thread 33 and the lower looper thread 34 is reduced in comparison with the case of the single needle overlock sewing in the case that the left needle 9A and the right needle 9B are positioned at an upper dead center, as shown in Fig. 18(c). This is because as shown in Fig. 21, the stitch width W of the upper looper thread 33 and the lower looper thread 34 is decreased in comparison with the cases of the single needle overlock sewing due to winding of the cloth.

Furthermore, in the case that the rolled hem sewing is selected by the stitch selecting dial 560, as shown in Fig. 17, since the stitch selecting cam 550 is moved to a position which is in a rightward position of the position in the case of the narrow hem sewing, the looper thread adjust cam follower 553 engaging with the looper thread adjust cam 550b of the stitch changeover cam plate 550 ascends along the looper thread adjust cam 550b. When the looper thread adjust cam follower 553 ascends, the pulleys 555 ascends to the intermediate position of the cam groove 513a of the shift adjust plate 513 so that the stitch width adjust and interlock wire 410 is ascended, thereby displacing the upper looper thread shifter 530 on which the stitch width adjust and interlock wire 410 is hooked to the same position as that in the single needle overlock. At this time, the narrow hem cam follower 556 engaging with

the narrow hem changeover cam 550a of the stitch changeover cam plate 550 ascends along the narrow hem changeover cam 550a so that the narrow hem changeover piece 558a is apart from the inlet port 530d of the upper looper thread shifter 530 and the inlet port 531c of the lower looper thread shifter 531 through the end surface cam 530c and the end surface cam 531b. Accordingly, the upper looper thread shifter 530 and the upper looper thread reciprocator 503c and 504c are disposed in positions having a relation in which a shift quantity of the upper looper thread 33 is increased in comparison with the case of the narrow hem sewing in the case that the left needle 9A and the right needle 9B are positioned at an upper dead center, as shown in Fig. 18(d). Further, the lower looper thread shifter 531 and the lower looper thread reciprocator 503d and 504d are disposed in positions having a relation in which a shift quantity of the lower looper thread 34 is decreased in comparison with the case of the narrow hem sewing in the case that the left needle 9A and the right needle 9B are positioned at an upper dead center. This is because as shown in Fig. 22, the upper looper thread 33 necessary for a stitch surrounds inside and outside of the stitch width W of the cloth and the lower looper thread 34 is directly connected to the upper looper thread 33 at a position of the outside surface of the cloth.

A concrete operation of feeding a thread by the thread feeding apparatus in accordance with the embodiment of the present invention will be explained below by using the upper looper thread upstream gripper 50, the upper looper thread downward gripper 80, the upper

looper thread reciprocators 503c and 504c and the upper looper thread shifter 530.

At a time of a cloth feeding, as shown in Fig. 8(b), since the upstream gripper 42 is pressed by the upstream gripper open arm 311, the elastic force from the compression spring 46 against the pair of grip plate 44 of the upper looper thread upstream gripper 50 is weakened due to a rightward motion of the thrust receiver 47 and the spring receiver 45 so that the upper looper thread upstream gripper 50 is opened. Further, at this time, since the downstream grip shaft 72 is not pressed by the downstream gripper open arm 314, the elastic force of the compression spring 46 is applied to the pair of grip plate 44 through the spring receiver 45. Accordingly, the upper looper thread downward gripper 80 is closed. At this time, the upper looper thread reciprocators 503c and 504c move rightward while pulling out the upper looper thread 32 from the bobbin 52, thereby shifting as a thread quantity necessary for a stitch of the stitch forming device 100.

Further, at a time of a stitch forming, as shown in Fig. 8(a), since the upstream gripper 42 is not pressed by the upstream gripper open arm 311, the elastic force of the compression spring of the upper looper thread upstream gripper 50 is applied to the pair of grip plates 44 through the spring receiver 45. Accordingly, the upper looper thread downstream gripper 80 is closed. Further, at this time, since the downstream grip shaft 72 is not pressed by the downstream gripper open arm 314, the elastic force from the compression spring 46 against the pair of grip plates 44 of the upper looper thread downstream gripper

80 is weakened due to a rightward motion of the thrust receiver 47 and the spring receiver 45 so that the upper looper thread downstream gripper 80 is opened. At this time, the upper looper thread reciprocators 503c and 504c moves leftwards, thereby releasing as a thread quantity necessary for a stitch of the stitch forming device 100.

Further, it is a matter of course that the same thread feeding operation is performed in the case of the left needle thread upstream gripper 40, the left needle thread reciprocators 503a and 504a, the needle thread shifter 514 and the left needle thread downstream gripper 70, the right needle thread upstream gripper 41, the right needle thread reciprocators 503b and 504b, the needle thread shifter 514 and the right needle thread downstream gripper 71, and the lower looper thread upstream gripper 60, the lower looper thread reciprocators 503d and 504d, the lower looper thread shifter 531 and the lower looper thread downstream gripper 90.

In the case of changing the stitch width for performing a stitch forming onto the cloth so as to adjust the thread quantity of the thread in the above thread feeding apparatus, the stitch width adjust dial 802 is rotated so as to displace the upper looper thread shifter 530 and the lower looper thread shifter 531 through the stitch width adjust and interlock wire 410 of the thread tension slightly adjusting means 400. Accordingly, when the stitch width adjust dial 802 is set such that the stitch width becomes wide, the stitch width adjust and interlock wire 410 is tensioned so that the upper looper thread shifter

530 and the lower looper thread shifter 531 are displaced leftwards. Therefore, since the shift quantity of the upper looper thread 33 and the lower looper thread 34 due to the upper looper thread reciprocators 503c and 504c and the lower looper thread reciprocators 503d and 504d can be increased, the thread quantity in the case that the stitch width W is wide shown in Figs. 19, 20, 21 and 22 can be increased.

Further, when the stitch width adjust dial 802 is set such that the stitch width becomes narrow, the stitch width adjust and interlock wire 410 is loosened so that the upper looper thread shifter 530 and the lower looper thread shifter 531 are pulled by the tension spring 533 so as to be displaced rightwards. Therefore, since the shift quantity of the upper looper thread 33 and the lower looper thread 34 due to the upper looper thread reciprocators 503c and 504c and the lower looper thread reciprocators 503d and 504d can be decreased, the thread quantity in the case that the stitch width W is narrow shown in Figs. 19, 20, 21 and 22 can be decreased.

Still further, in the case of adjusting the thread quantity of the thread in correspondence to the change of the stitch feeding quantity at a time of forming the stitch onto the cloth, the feed quantity adjust dial 930 is rotated so as to rotate the stitch feed adjust arm 421 fixed to the adjust arm 934, thereby rotating the stitch feed adjust and shift lever 520 through the stitch feed adjust and interlock wire 420 of the thread tension slightly adjusting means 400. Accordingly, the needle thread shifter 514 engaging with the needle thread shifter drive shaft 520a of the stitch feed adjust and shift

lever 520 is displaced. At the same time, since the shift adjust plate 513 connected to the stitch feed adjust and shift lever 520 through the connecting link 517 is displaced, the pulley 555 engaging with the cam groove 513a of the shift adjust plate 513 is displaced so that the upper looper thread shifter 530 and the lower looper thread shifter 531 are displaced through the stitch width adjust and interlock wire 410.

Accordingly, when the feed quantity adjust dial 930 is rotated for changing a stitch feed pitch P as shown in Figs. 19, 20, 21 and 22, the needle thread shifter 514 can be interlocked with the stitch feed adjust portion 900 through the thread tension slightly adjusting means 400, thereby corresponding to the thread quantity necessary for a stitch which changes in response to the operation of the feed quantity adjust dial 930. At this time, since the thread quantity of not only the left needle thread 31 and the right needle thread 32 but also the upper looper thread 33 and the lower looper thread 34 is slightly changed due to the change of the stitch feed pitch P, the upper looper thread shifter 530 and the lower looper thread shifter 530 are interlocked with the stitch feed adjust portion 900 through the thread tension slightly adjusting means 400.

In this case, the thread feeding apparatus is provided with a cloth thickness adjust and interlock means 700 as shown in Figs. 13 and 23 for driving the needle thread shifter 514, the looper thread shifter 530 and the lower looper thread shifter 531 in a manner of interlocking with the corresponding thread quantity necessary for a

stitch which changes in response to the cloth thickness due to a pressure foot 1050. The cloth thickness adjust and interlock means 700 interlocks the needle thread shifter 514, the looper thread shifter 530 and the lower looper thread shifter 531 with the cloth thickness by a cloth thickness detecting arm 701 which is rotatably fixed to the machine casing 1 by a caulking stepped pin 702. Concretely speaking, an end of the cloth thickness detecting arm 701 is engaged with a cloth thickness detecting pin 703 fixed to a pressure rod 1051 for mounting the pressure foot 1050 to the machine casing 1 around the mounting position by the caulking pin 702. Further, the other end is rotatably fixed to the pulley 524 for hooking the stitch feed adjust and interlock wire 420 introduced from the pulley 424B by a caulking stepped shaft 704. Accordingly, the pulley 524 is not fixed to the pulley shaft 523 of the thread feed unit base plate 501 in the above overlock sewing machine, thereby interlocking with the pressure foot 1050.

The cloth thickness adjust and interlock means 700 is structured such that when the cloth press quantity of the pressure foot 1050 is changed at a time of forming the stitch onto the cloth, the cloth thickness detecting arm 701 fixed to the pressure rod 1051 rotates in correspondence to the change value thereof. Since the stitch feed adjust and shift lever 520 is rotated by the rotating operation of the cloth thickness detecting arm 701 through the stitch feed adjust and interlock wire 420, the needle thread shifter 514, the looper thread shifter 530 and the lower looper thread shifter 531 are displaced. Accordingly, the needle thread shifter 514, the looper thread shifter

530 and the lower looper thread shifter 531 are displaced in correspondence to the thread quantity necessary for a stitch which changes in response to the cloth thickness of the pressure foot 1050.

In the present embodiment, the left needle thread reciprocators 503a and 504a, the right needle thread reciprocators 503b and 504b, the upper looper thread reciprocators 503c and 504c and the lower looper reciprocators 503d and 504d are respectively formed with respect to the pair of reciprocators 503 and 504, however, the present invention is not limited to this structure so that each of the reciprocators may be individually provided.

Further, in the present embodiment, the thread feeding apparatus for the sewing machine is applied to an overlock sewing machine having double needles and four threads, however, the present invention is not limited to this structure so that it can be applied to an overlock sewing machine having a needle and three threads.

The thread feeding apparatus for the sewing machine according to the present invention is also applied to a lock stitch sewing machine or an embroidery sewing machine having a rotary looptaker, hook, or shuttle, respectively.

As mentioned above, in accordance with the thread feeding apparatus for a sewing machine of the present invention, since the thread can be fed to the stitch forming device as the thread quantity necessary for a stitch only by shifting and releasing the thread by means of the reciprocator, the mechanism can be simplified. Further, since the shifter for adjusting the shift quantity shifted by the

reciprocator adjusts in correspondence to the thread quantity necessary for a stitch which changes in response to the stitch width for performing the stitch forming to the cloth, the stitch length and/or the cloth thickness by the pressure foot, the apparatus can correspond to a number of the needles and the narrow hem or rolled hem sewing. Accordingly, the accuracy of the sewing machine can be secured, and the durability of the apparatus can be improved so as to correspond to high speed sewing.

Further, since the upper gripper, the lower gripper and the reciprocator can be driven in an interlocking manner with the stitch forming device, a thread can be supplied to the stitch forming device for performing a stitch forming onto a cloth without the need for a stitch balancing thread tension.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A thread feeding apparatus for a sewing machine which feeds a thread to a stitch forming device for stitch forming on a cloth, said thread feeding apparatus comprising:

an upstream gripper for gripping said thread fed from a thread spool, said upstream gripper being closed by the stitch forming device at a time of forming the stitch and opened at a time of feeding of said cloth;

a downstream gripper for gripping said thread introduced from said upstream gripper, said downstream gripper being open at a time of said stitch forming to allow said thread to be pulled by said stitch forming device and being closed at a time of feeding of said cloth; and

a reciprocator synchronously driven with said stitch forming device to shift said thread from a thread path extending between said open upstream gripper and said closed downstream gripper at the time of feeding of said cloth to provide a thread quantity necessary for one stitch and to release said thread at the time of forming said stitch, said reciprocator being disposed between a pair of thread guides spaced between said upstream gripper and said downstream gripper and wherein said reciprocator has an inlet port for receiving said thread, a thread support at a point in the thread path aligning with said pair of thread guides and a sloped surface for guiding said thread from the inlet port to the thread support.

2. A thread feeding apparatus for a sewing machine which feeds a needle thread, an upper looper thread and a lower looper thread to a

needle, an upper looper and a lower looper, respectively, of a stitch forming device for forming a stitch in a cloth, said thread feeding apparatus comprising:

a needle thread upstream gripper, an upper looper thread upstream gripper and a lower looper upstream gripper for gripping, respectively, said needle thread, said upper looper thread and said lower looper thread, the threads being respectively fed from thread spools, said upstream grippers being closed by said stitch forming device when forming the stitch and opened by said stitch forming device when feeding the cloth;

a needle thread downstream gripper, an upper looper thread downstream gripper and a lower looper downstream gripper for gripping, respectively, said needle thread, said upper looper thread and said lower looper thread respectively introduced from said needle thread upstream gripper, said upper looper upstream gripper and said lower looper upstream gripper, said downstream grippers being opened when stitch forming to allow said needle thread, said upper looper thread and said lower looper thread to be pulled by said stitch forming device and closed when cloth feeding; and

a needle thread reciprocator, an upper looper thread reciprocator and a lower looper thread reciprocator synchronously driven with said needle, said upper looper and said lower looper, respectively, for shifting said needle thread, said upper looper thread and said lower looper thread from thread paths respectively extending between said opened needle thread upstream gripper and said closed needle thread downstream gripper, between said opened upper looper thread upstream gripper and said closed upper looper thread downstream gripper and between said opened lower looper thread upstream gripper and said closed

lower looper thread downstream gripper when feeding the cloth, the shifting from said thread paths corresponding to the thread quantities respectively necessary for forming one stitch by said stitch forming device, and for releasing said needle thread, said upper looper thread and said lower looper thread when forming said one stitch.

3. A thread feeding apparatus for a sewing machine as recited in claim 2, further comprising a needle thread shifter, an upper looper thread shifter and a lower looper thread shifter for respectively adjusting extent of the shifts from the thread paths by said needle thread reciprocator, said upper looper thread reciprocator and said lower looper thread reciprocator, in correspondence to stitch length and cloth thickness.

4. A thread feeding apparatus for a sewing machine which feeds a needle thread, an upper looper thread and a lower looper thread to a needle, an upper looper and a lower looper, respectively, of a stitch forming device for forming a stitch in a cloth, said thread feeding apparatus comprising:

a needle thread upstream gripper, an upper looper thread upstream gripper and a lower looper upstream gripper for gripping, respectively said needle thread, said upper looper thread and said lower looper thread respectively fed from thread spools, said upstream grippers being closed by said stitch forming device when forming the stitch and opened by said stitch forming device when feeding the cloth;

a needle thread downstream gripper, an upper looper thread downstream gripper and a lower looper downstream gripper for gripping, respectively, said needle thread, said upper looper thread and said lower looper thread respectively introduced from said needle thread

upstream gripper, said upper looper upstream gripper and said lower looper upstream gripper, said downstream grippers being opened when stitch forming to allow said needle thread, said upper looper thread and said lower looper thread to be pulled by said stitch forming device and closed when cloth feeding;

a needle thread reciprocator, an upper looper thread reciprocator and a lower looper thread reciprocator for respectively shifting said needle thread, said upper looper thread and said lower looper thread from thread paths respectively extending between said opened needle thread upstream gripper and said closed needle thread downstream gripper, between said opened upper looper thread upstream gripper and said closed upper looper thread downstream gripper and between said opened lower looper thread upstream gripper and said closed lower looper thread downstream gripper when feeding the cloth, the shifting from said thread paths corresponding to the thread quantities respectively necessary for forming one stitch by said stitch forming device, and for releasing said needle thread, said upper looper thread and said lower looper thread when forming said one stitch;

a needle thread shifter, an upper looper thread shifter and a lower looper thread shifter for respectively adjusting the extent of the shifts of said threads by said needle thread reciprocator, said upper looper thread reciprocator and said lower looper thread reciprocator in correspondence to thread quantities necessary for forming one stitch, which thread quantities change with changes in stitch width, stitch length or cloth thickness, or both; and

change-over means for displacing said needle thread shifter, said upper looper thread shifter and said lower looper thread shifter in

correspondence to number of needles used to form the stitch and/or the stitch width.

5. A thread feeding apparatus for a sewing machine which feeds a needle thread, an upper looper thread and a lower looper thread to a needle, an upper looper and a lower looper, respectively, of a stitch forming device for forming a stitch in a cloth, said thread feeding apparatus comprising:

a needle thread upstream gripper, an upper looper thread upstream gripper and a lower looper upstream gripper for gripping, respectively, said needle thread, said upper looper thread and said lower looper thread, the threads being respectively fed from thread spools, said upstream grippers being closed by said stitch forming device when forming the stitch and opened by said stitch forming device when feeding the cloth;

a needle thread downstream gripper, an upper looper thread downstream gripper and a lower looper downstream gripper for gripping, respectively, said needle thread, said upper looper thread and said lower looper thread respectively introduced from said needle thread upstream gripper, said upper looper upstream gripper and said lower looper upstream gripper, said downstream grippers being opened when stitch forming to allow said needle thread, said upper looper thread and said lower looper thread to be pulled by said stitch forming device and closed when cloth feeding;

a needle thread reciprocator, an upper looper thread reciprocator and a lower looper thread reciprocator for respectively shifting said needle thread, said upper looper thread and said lower looper thread from thread paths respectively extending between said opened needle

thread upstream gripper and said closed needle thread downstream gripper, between said opened upper looper thread upstream gripper and said closed upper looper thread downstream gripper and between said opened lower looper thread upstream gripper and said closed lower looper thread downstream gripper when feeding the cloth, the shifting from said thread paths corresponding to the thread quantities respectively necessary for forming one stitch by said stitch forming device, and for releasing said needle thread, said upper looper thread and said lower looper thread when forming said stitch;

a needle thread shifter, an upper looper thread shifter and a lower looper thread shifter for respectively adjusting the extent of the shifts of said threads by said needle thread reciprocator, said upper looper thread reciprocator and said lower looper thread reciprocator in correspondence to thread quantities necessary for forming one stitch, which thread quantities change with changes in stitch width, stitch length or a cloth thickness, or both; and

change-over means for respectively displacing said upper looper thread shifter and said lower looper thread shifter in such a manner that, in hem sewing, the extent of the shift of said upper looper thread becomes equal to the extent of the shift of said lower looper thread and, in rolled hem sewing, the extent of the shift of said upper looper thread is increased and the extent of the shift of said lower looper thread is decreased.

6. A thread feeding apparatus for a sewing machine which feeds a thread to a stitch forming device for stitch forming on a cloth, said thread feeding apparatus comprising:

an upstream gripper for gripping the thread fed from a thread spool, said upstream gripper comprising a pair of grip plates biased together by a compression spring, said upstream gripper being closed by said stitch forming device at a time of forming the stitch and opened at a time of feeding of the cloth;

a downstream gripper for gripping the thread introduced from said upstream gripper and comprising a pair of grip plates biased together by a compression spring, said downstream gripper being open at the time of forming the stitch to allow the thread to be pulled by said stitch forming device and being closed at the time of feeding of the cloth; and

a reciprocator synchronously driven with said stitch forming device to shift the thread from a thread path extending between said open upstream gripper and said closed downstream gripper at the time of feeding of the cloth to provide a thread quantity necessary for one stitch and to release the thread at the time of forming the stitch;

said reciprocator being disposed between a pair of thread guides arranged between said upstream gripper and said downstream gripper and spaced in direction of feed of the thread.

7. A thread feeding apparatus for a sewing machine as recited in claim 6, wherein said reciprocator has a sloped surface for receiving the thread from an inlet port and for guiding the received thread to a point in the thread path aligning with said pair of thread guides.

8. A thread feeding apparatus for a sewing machine as recited in claim 6, further comprising a shifter for adjusting extent of the shifts from the thread paths by said reciprocator and the corresponding thread quantity, responsive to changes in stitch width, stitch length or cloth thickness, or both.

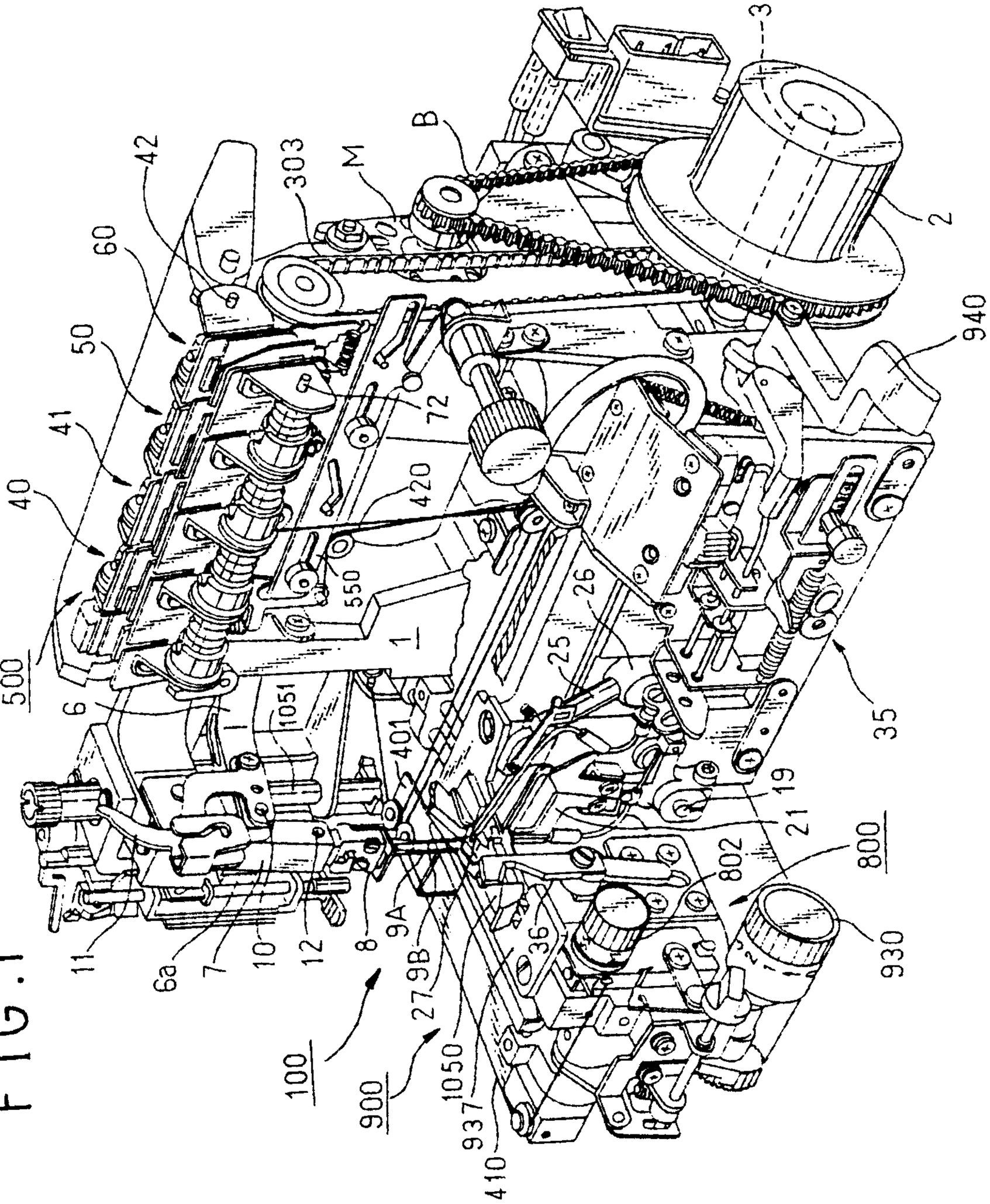

3
B
42
303
M
2
60
940
50
72
41
420
40
550
26
1
500
6
1051
25
35
401
19
21
802
800
11
6a
7
10
12
8
9A
9B
27
930
100
900
1050
937
410

FIG.1

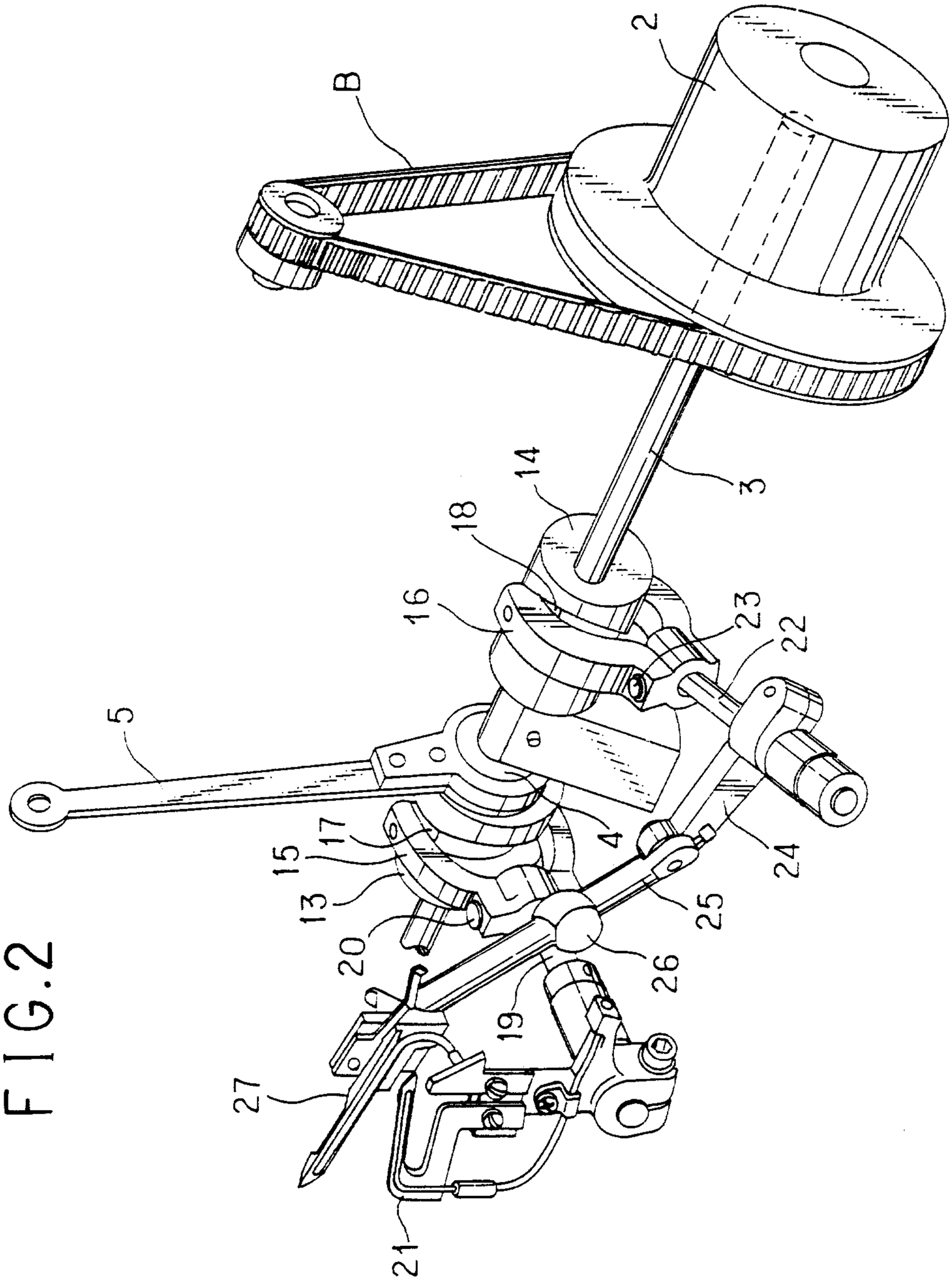


FIG.2

FIG.3

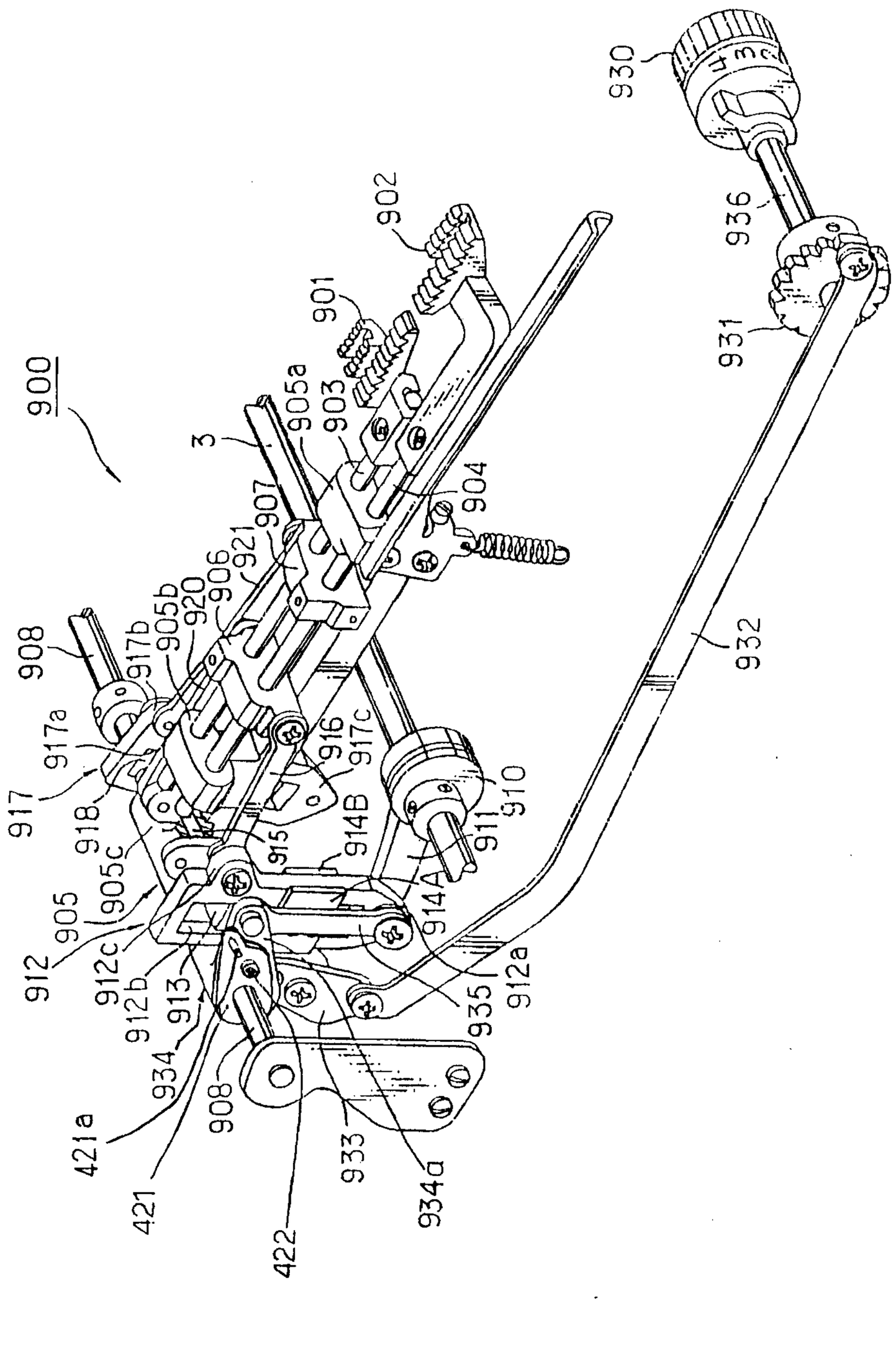

900
901
902
903
904
905
905a
905b
905c
906
907
908
910
911
912
912a
912b
912c
913
914A
914B
915
916
917
917a
917b
917c
918
920
921
930
931
932
933
934
934a
935
936
421
421a
422
3

FIG.4

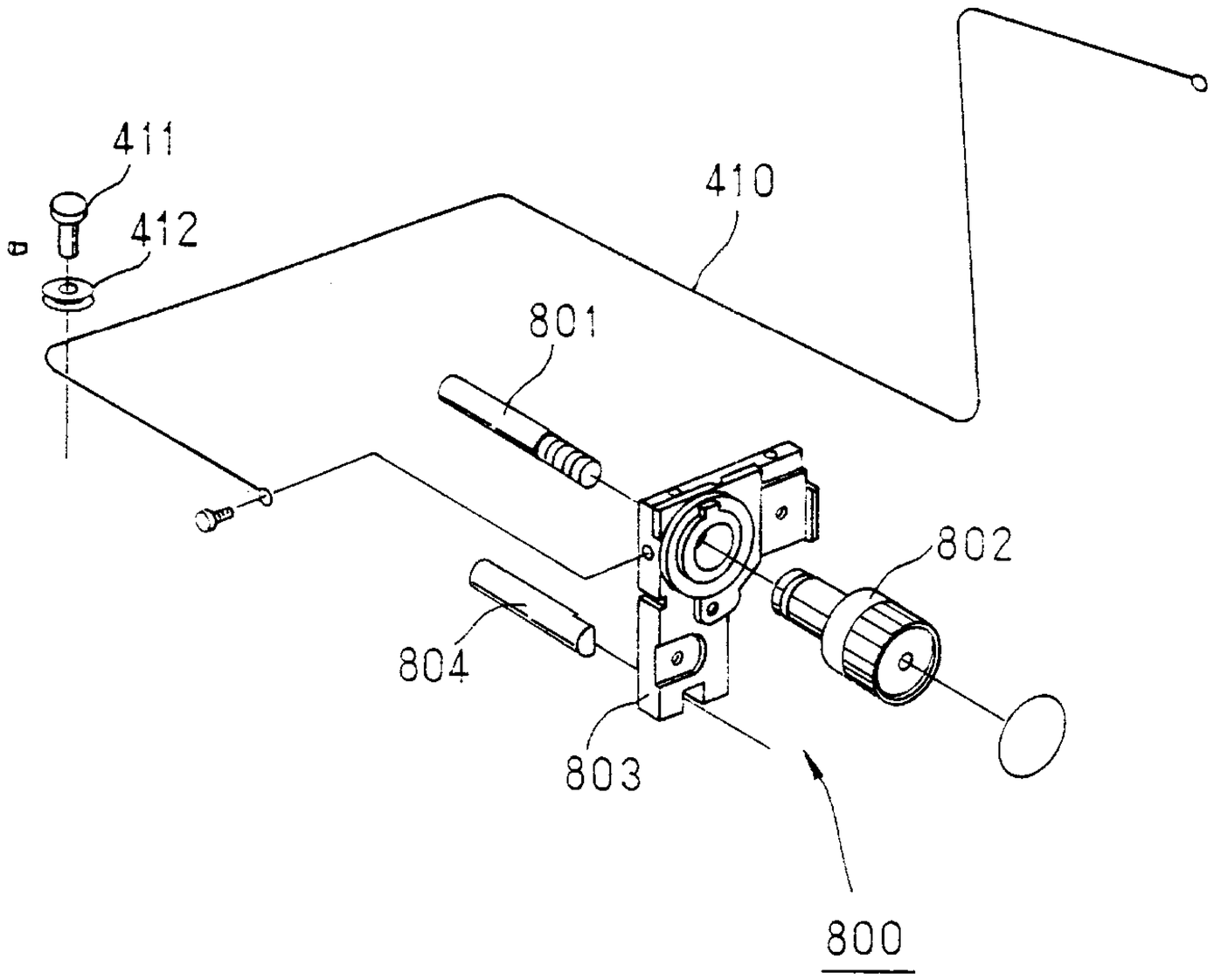


FIG.5

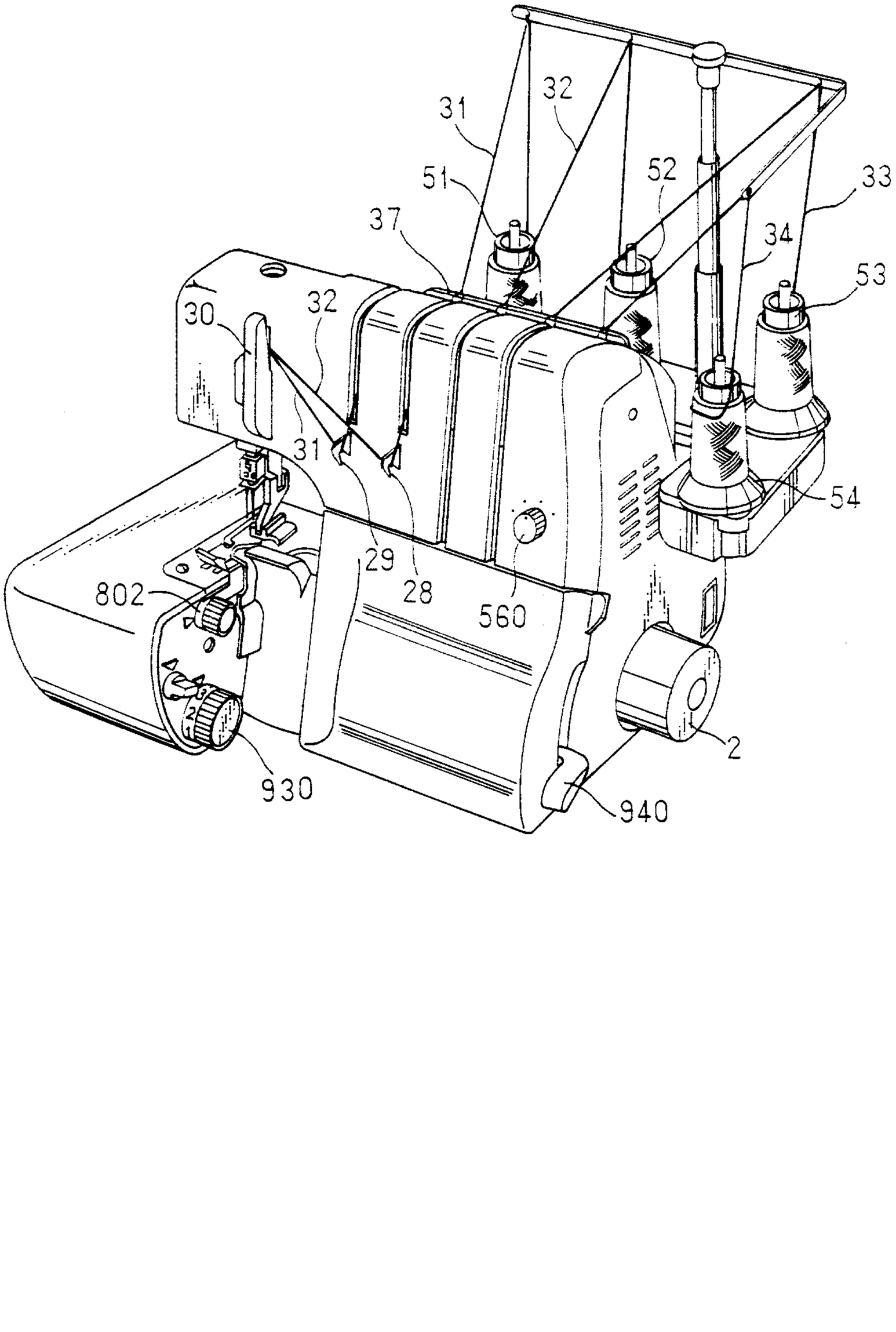


FIG.6

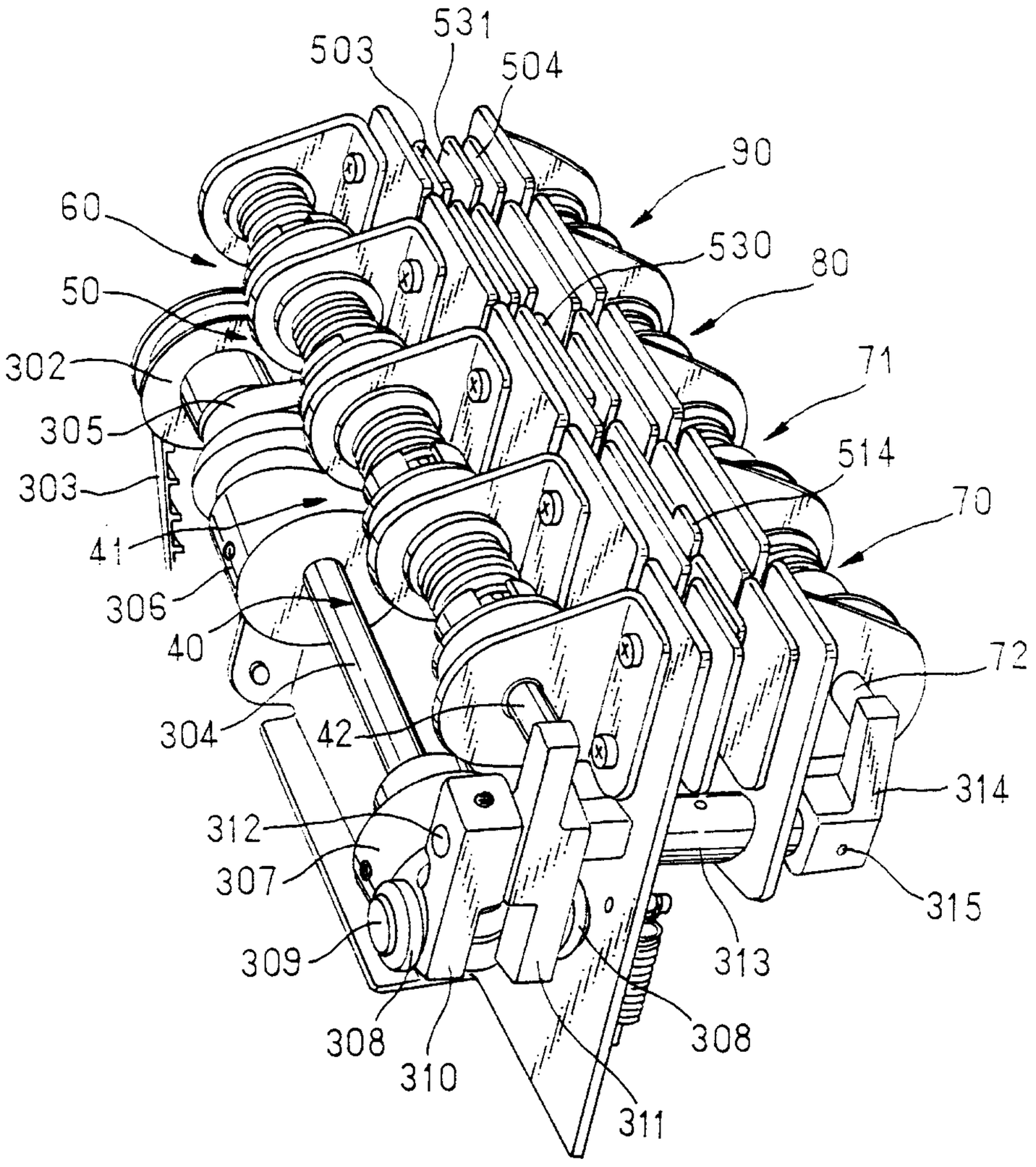

503
531
504
90
60
530
80
50
71
302
305
514
303
70
41
306
72
40
304
42
314
312
307
315
309
313
308
308
310
311

FIG.7

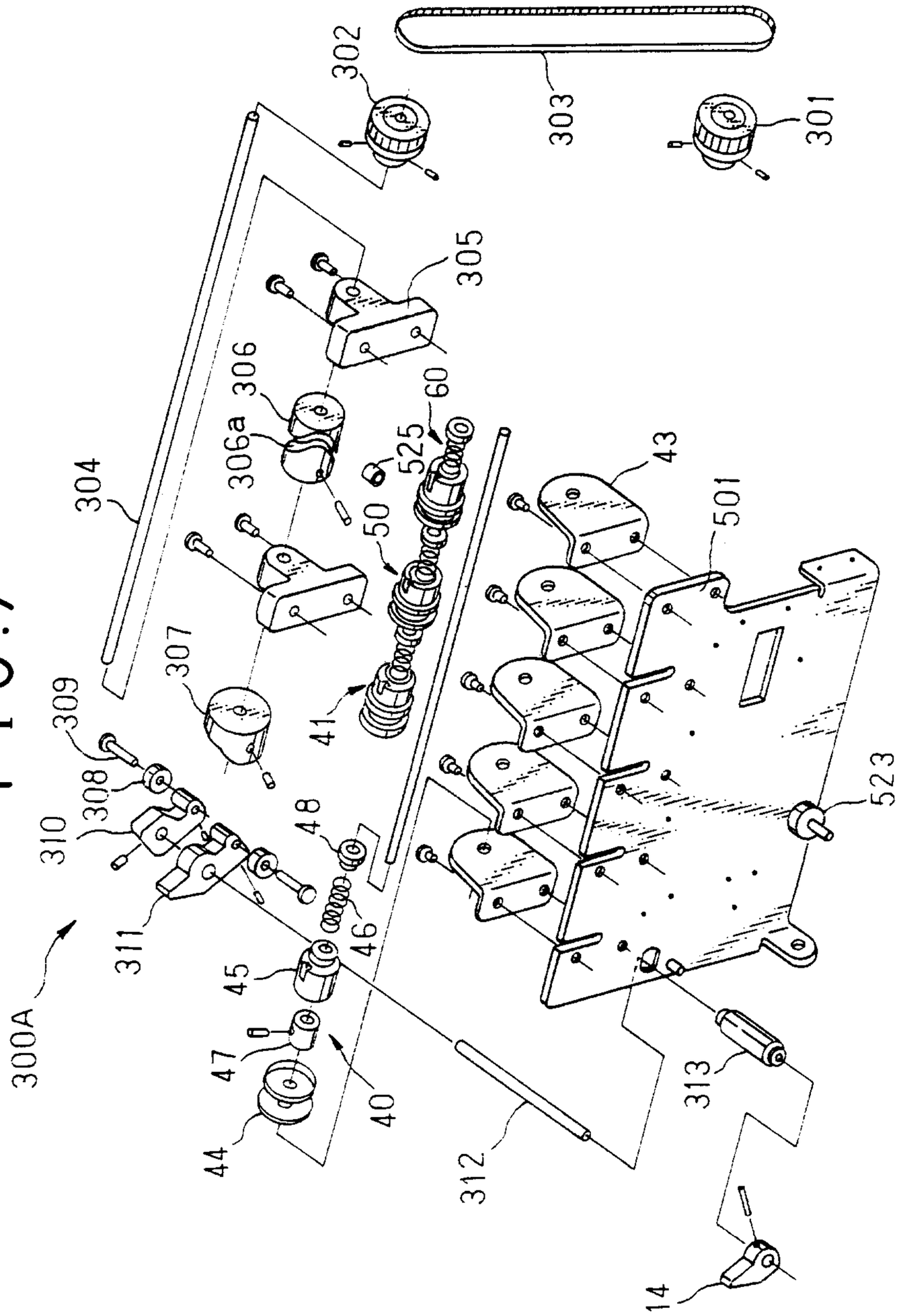

302
303
301
305
306
306a
60
525
304
50
43
501
307
309
41
308
310
48
523
311
46
45
47
300A
40
44
312
313
314

FIG.8a

THREAD GRIPPING

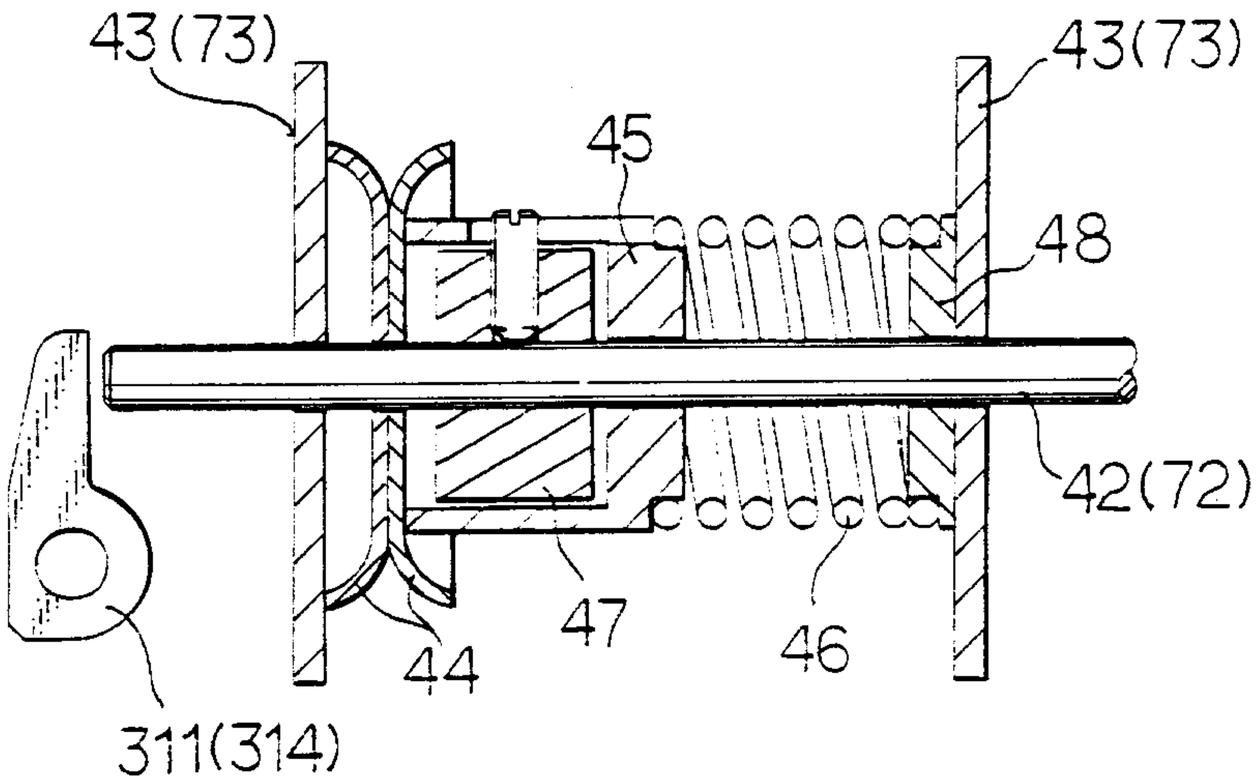


FIG.8b

THREAD RELEASING

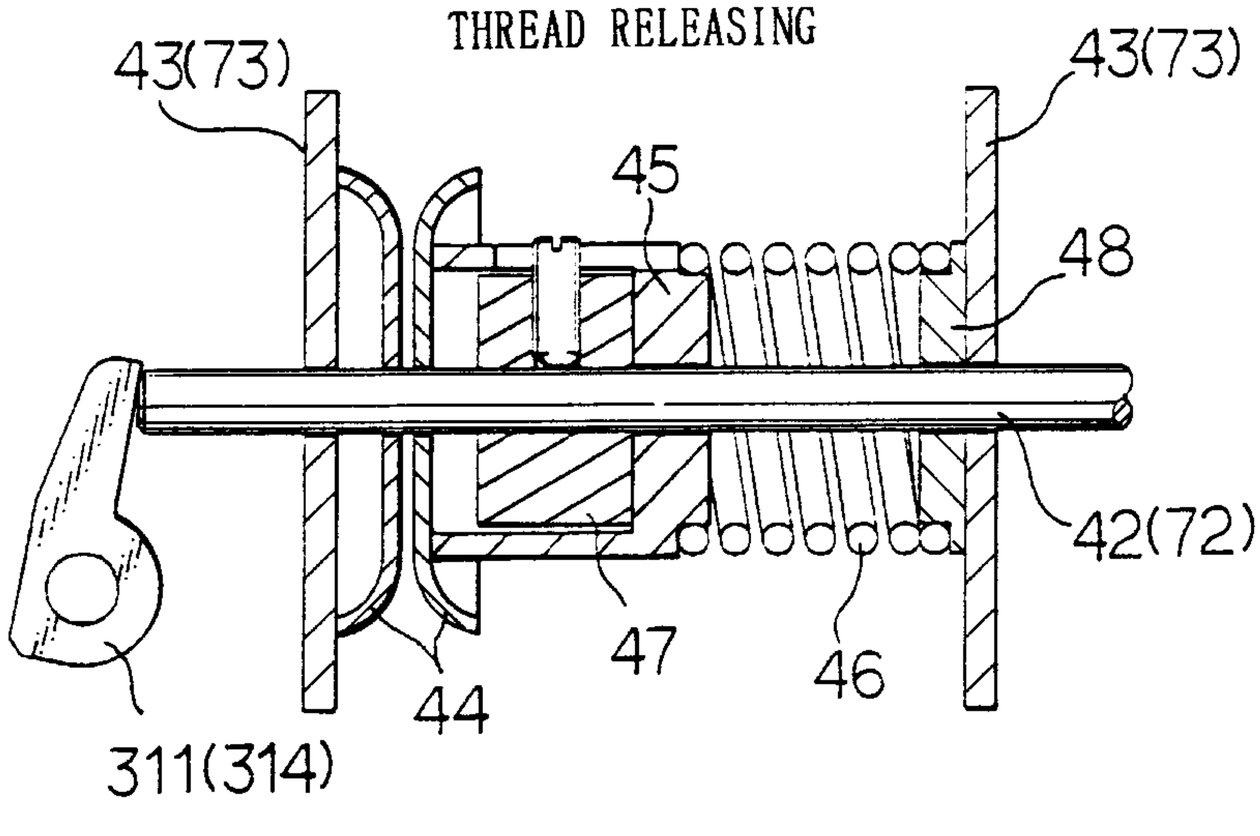


FIG.9

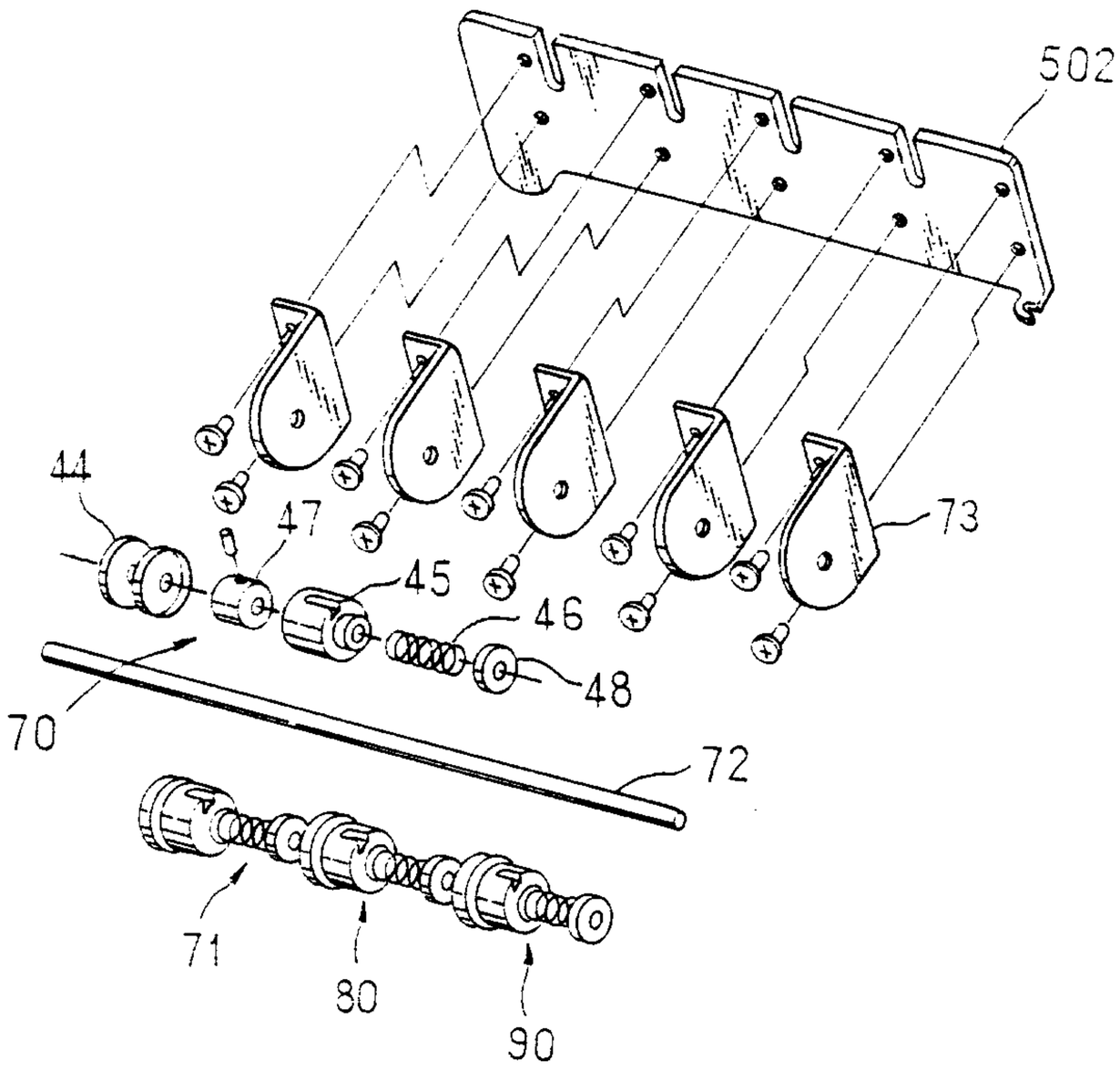


FIG.10

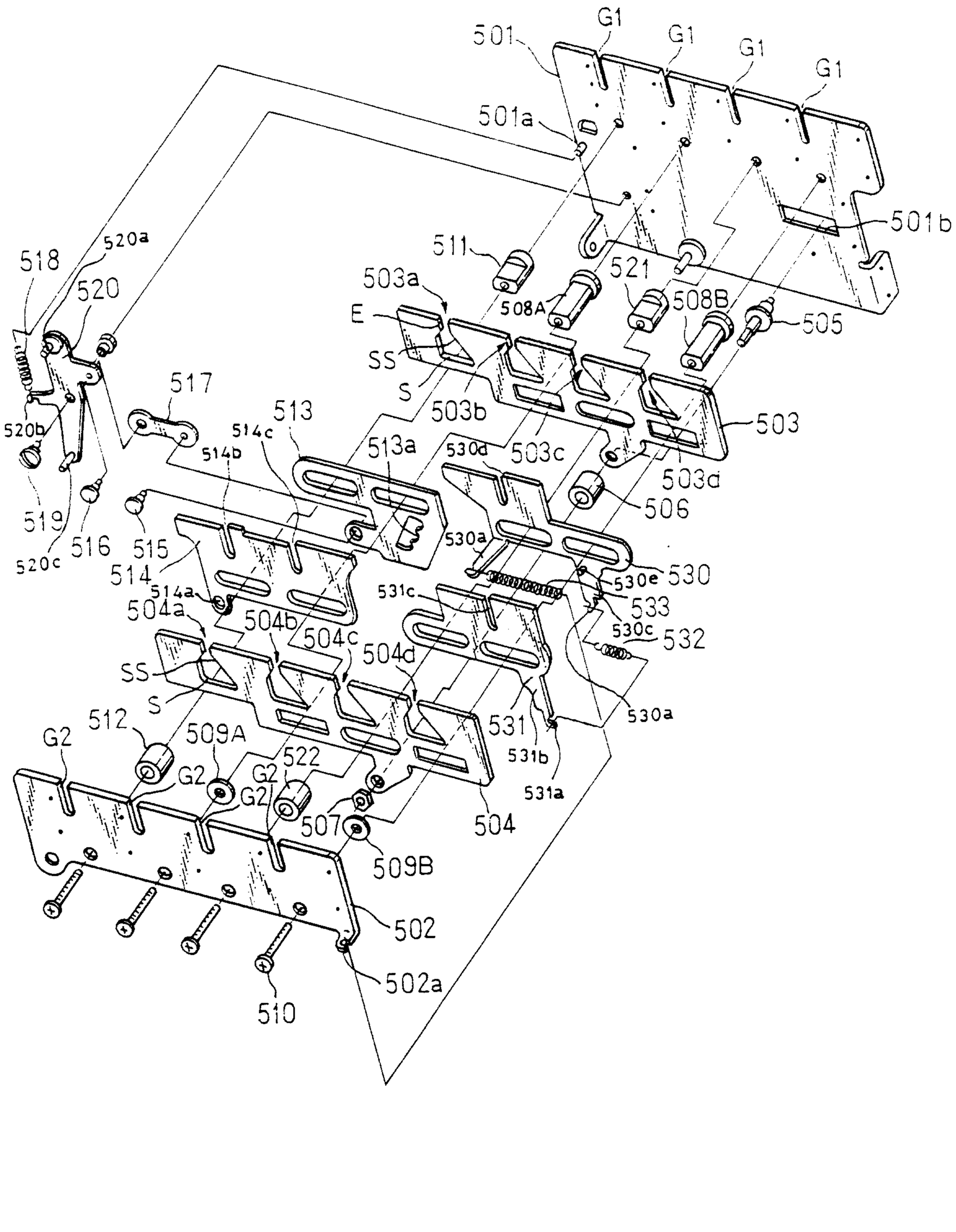

501
G1
G1
G1
G1
501a
501b
511
521
503a
508A
508B
505
E
SS
S
503b
503
513
514c
513a
530d
503c
503d
517
514b
506
518
520a
520
520b
519
516
515
520c
530a
530
530e
514
514a
531c
533
504a
504b
504c
504d
530c
532
SS
S
512
509A
522
531
530a
G2
G2
G2
G2
531b
531a
507
504
509B
502
502a
510

FIG.11

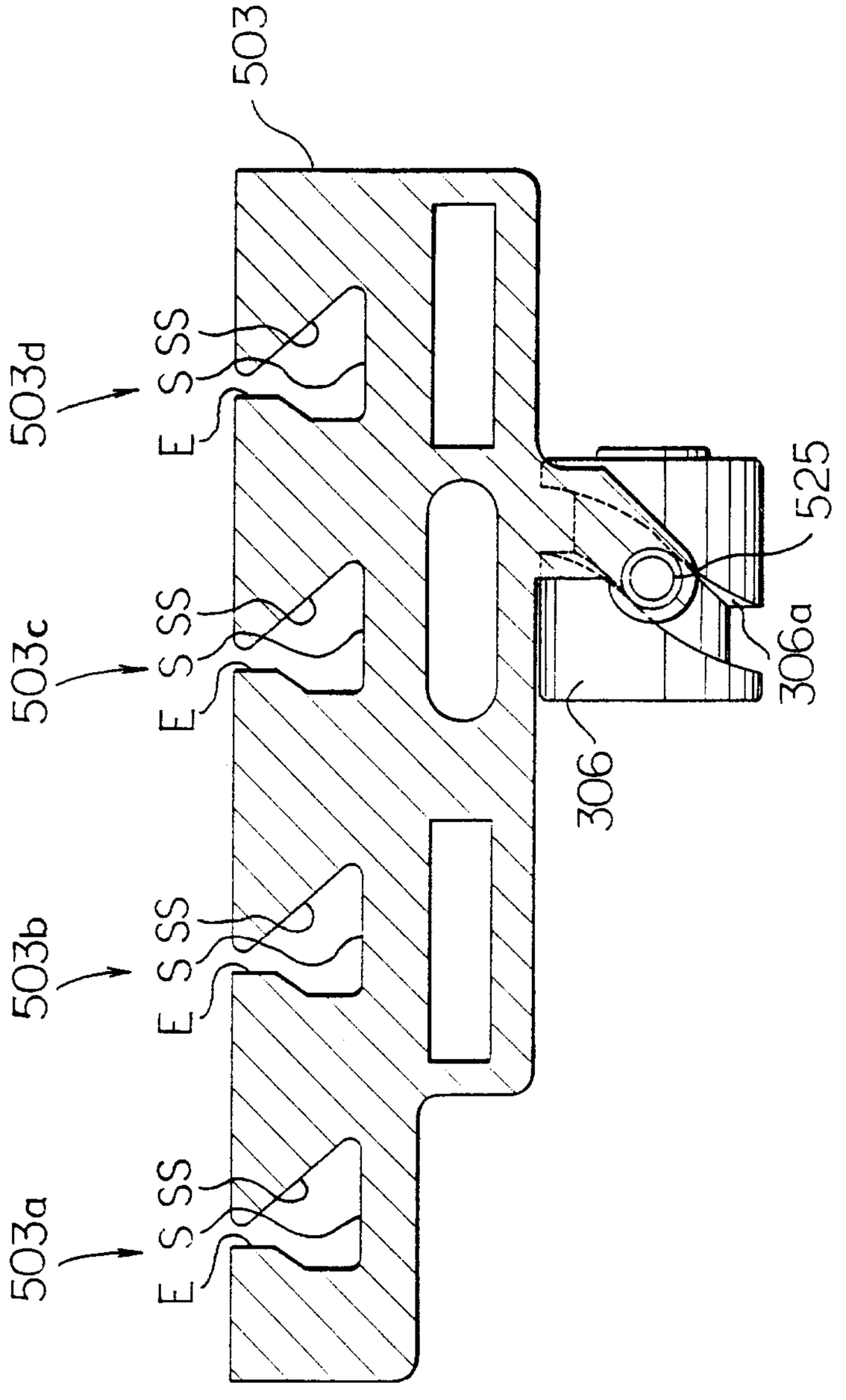


FIG.12

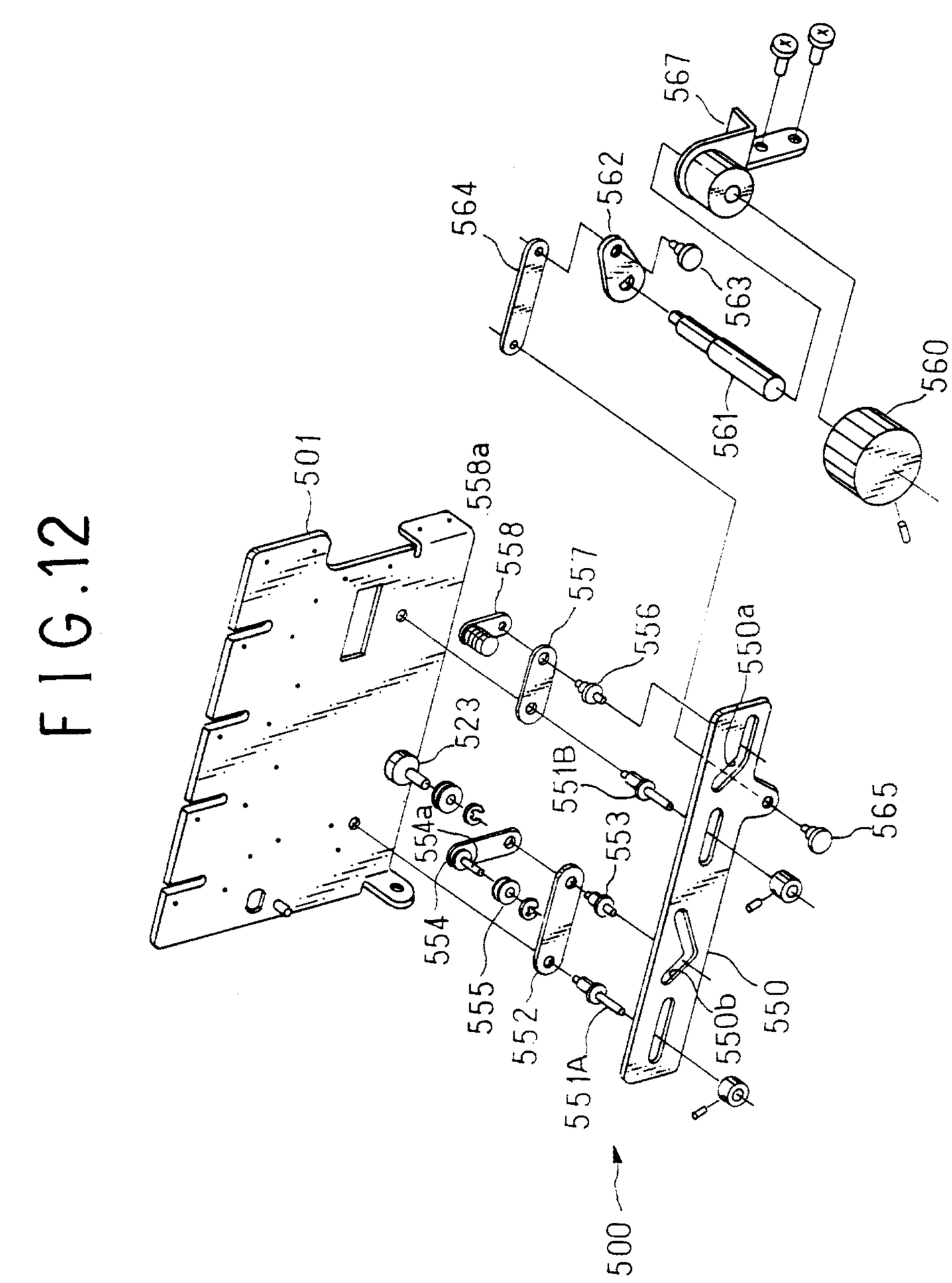

500
501
558a
558
557
556
550a
523
551B
554a
553
554
555
552
551A
550b
550
565
564
562
563
561
560
567

FIG.13

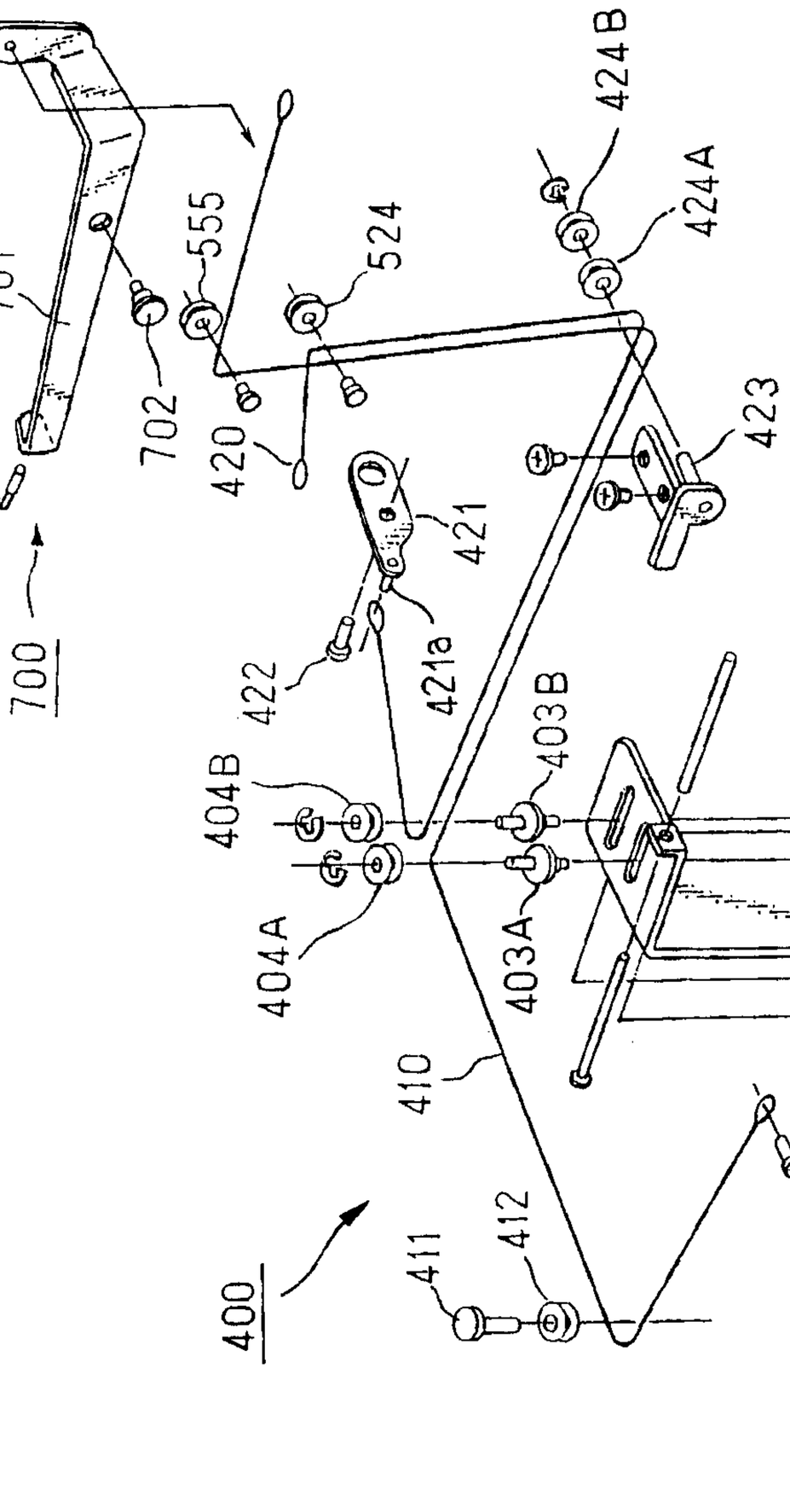

700
701
702
703
555
524
420
424B
424A
423
421
421a
422
400
404B
404A
403B
403A
401
402B
402A
405
406
409
410
411
412

FIG.14

DOUBLE NEEDLE DOUBLE CHAIN STITCH AND TRIPLE NEEDLES OVERLOCK SEWING

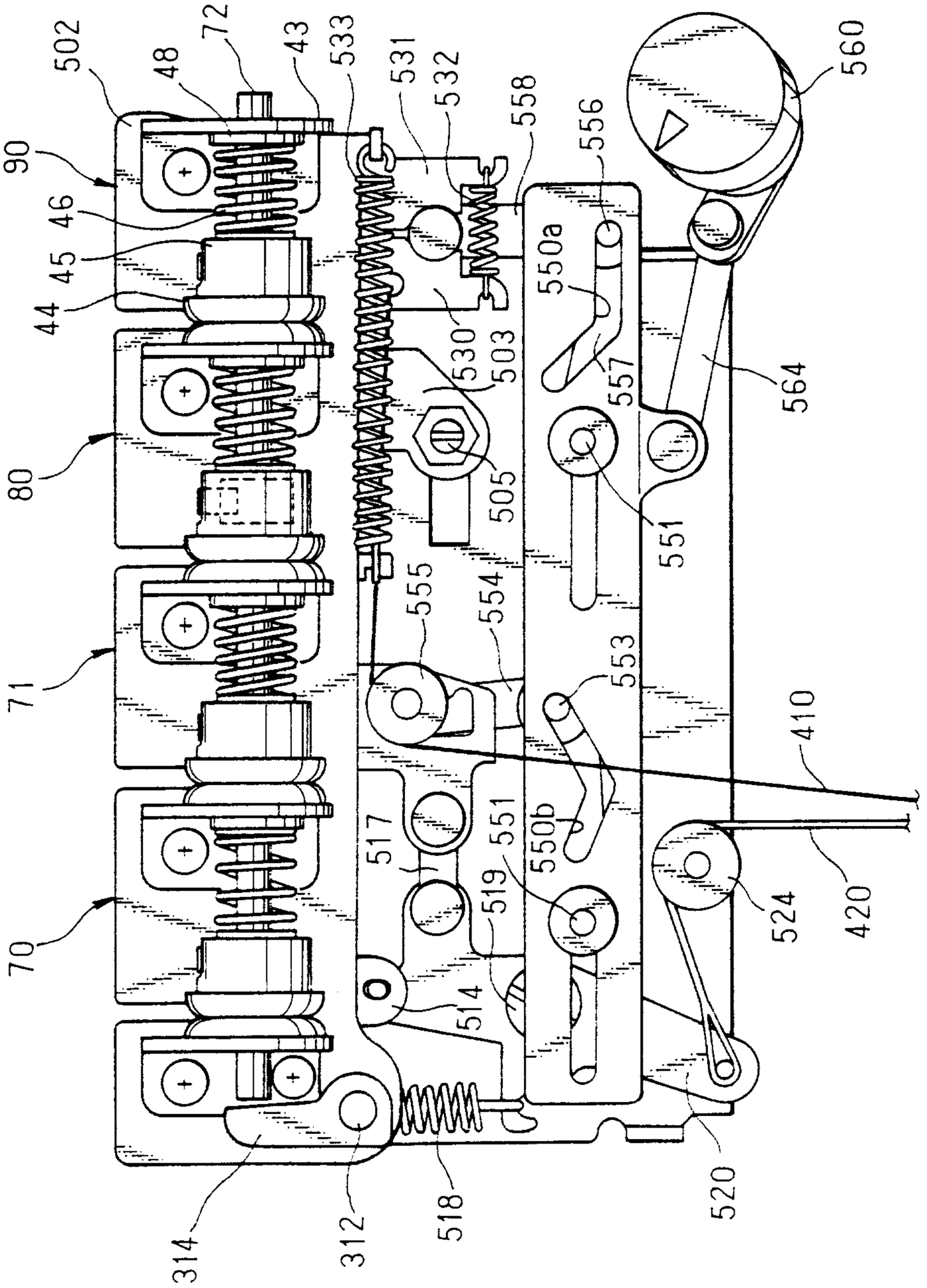


FIG.15
SINGLE NEEDLE OVERLOCK SEWING

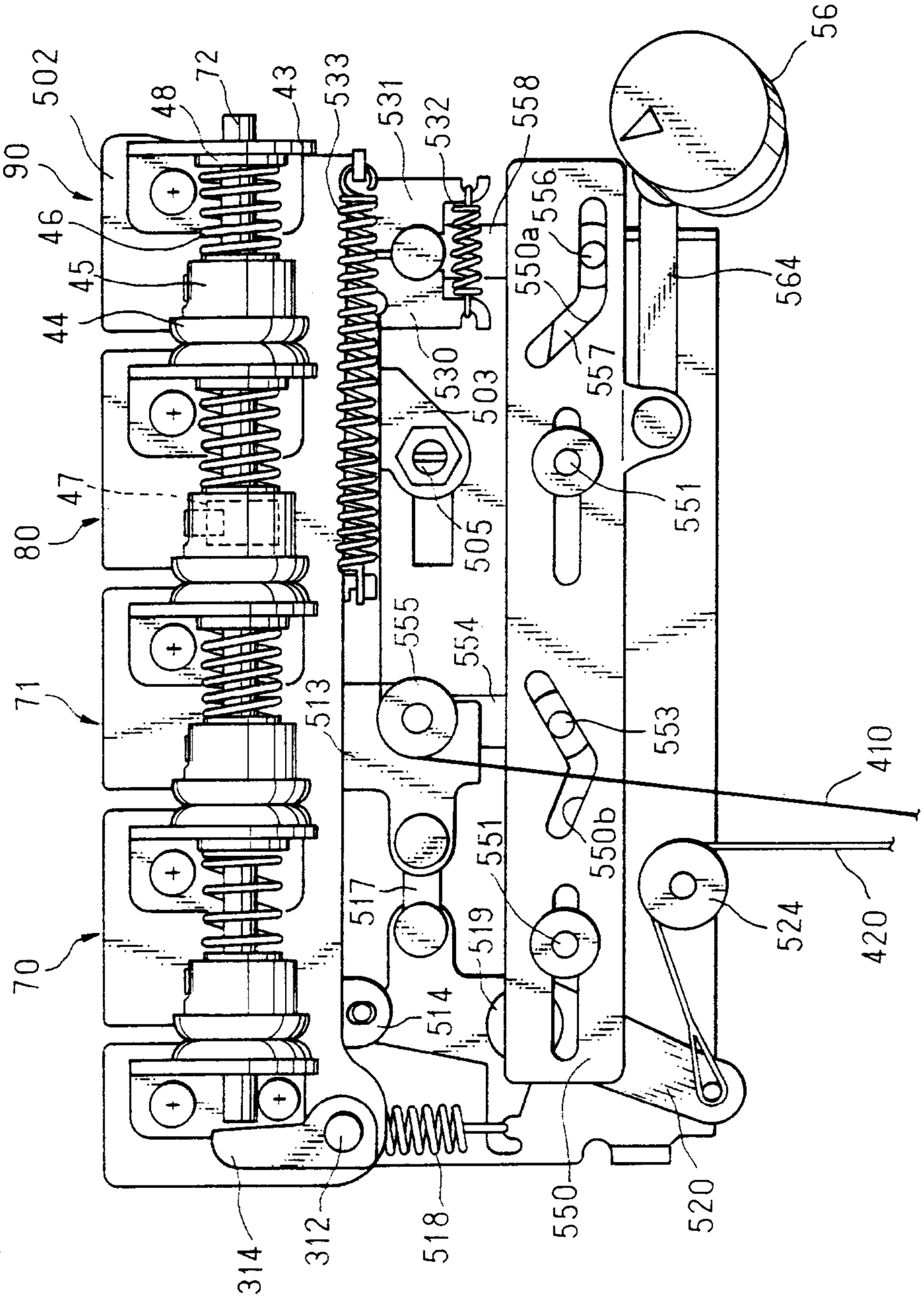
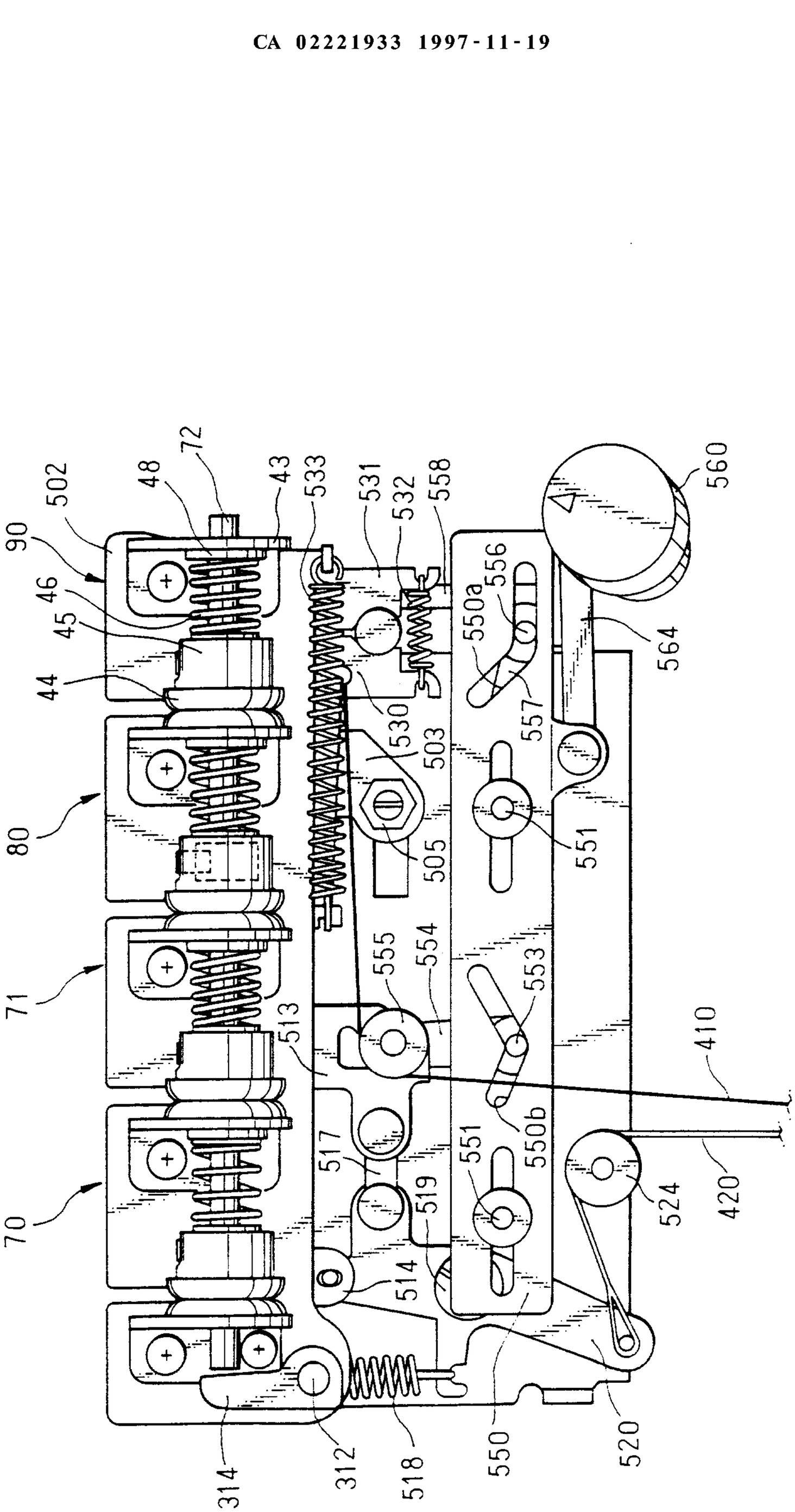


FIG. 16
NARROW HEM SEWING



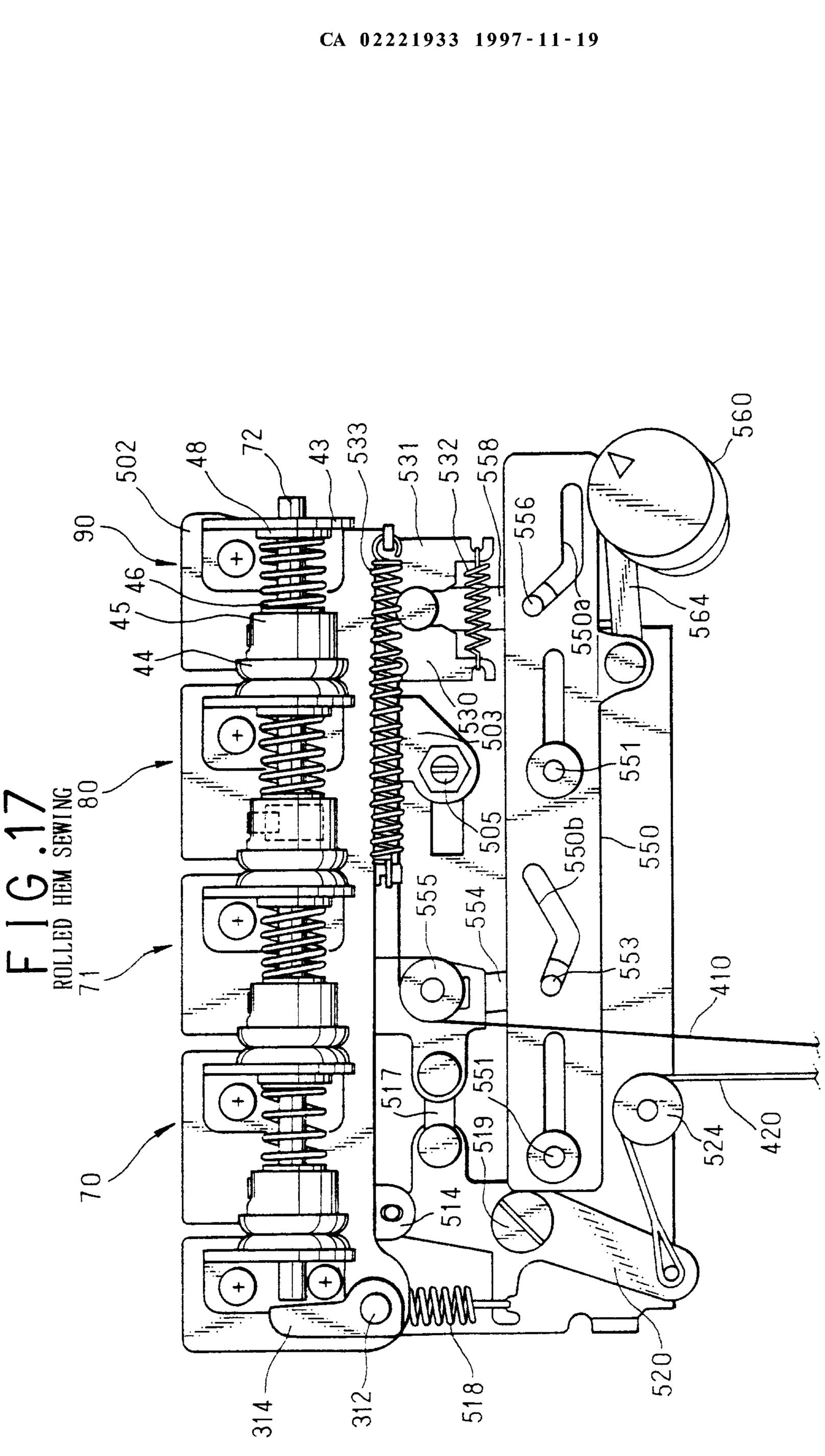


FIG. 17
ROLLED HEM SEWING

FIG.18

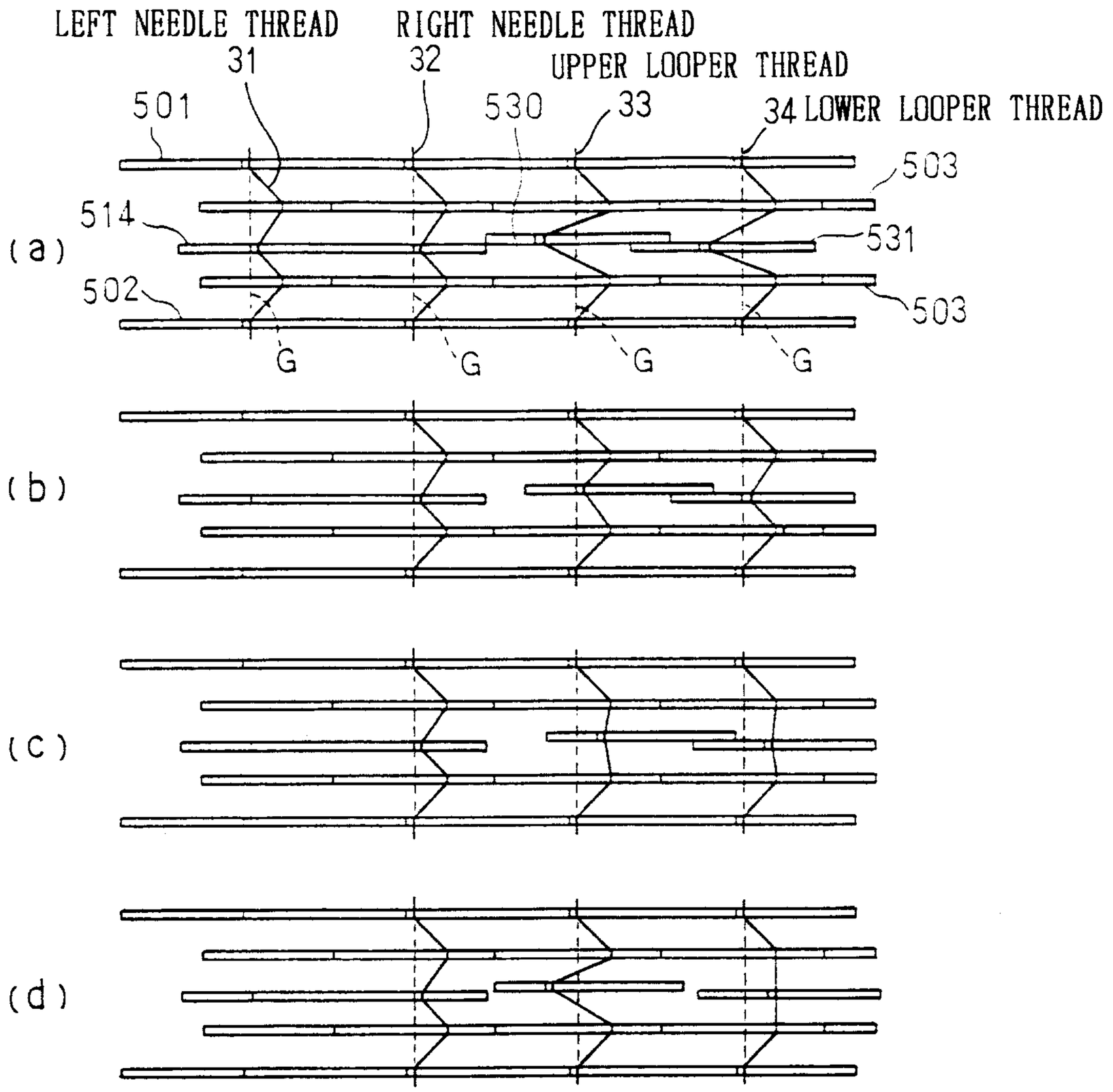

LEFT NEEDLE THREAD
RIGHT NEEDLE THREAD
UPPER LOOPER THREAD
LOWER LOOPER THREAD
31
32
33
34
501
530
503
514
531
502
503
G
G
G
G
(a)
(b)
(c)
(d)

FIG.19

DOUBLE NEEDLES OVERLOCK SEWING

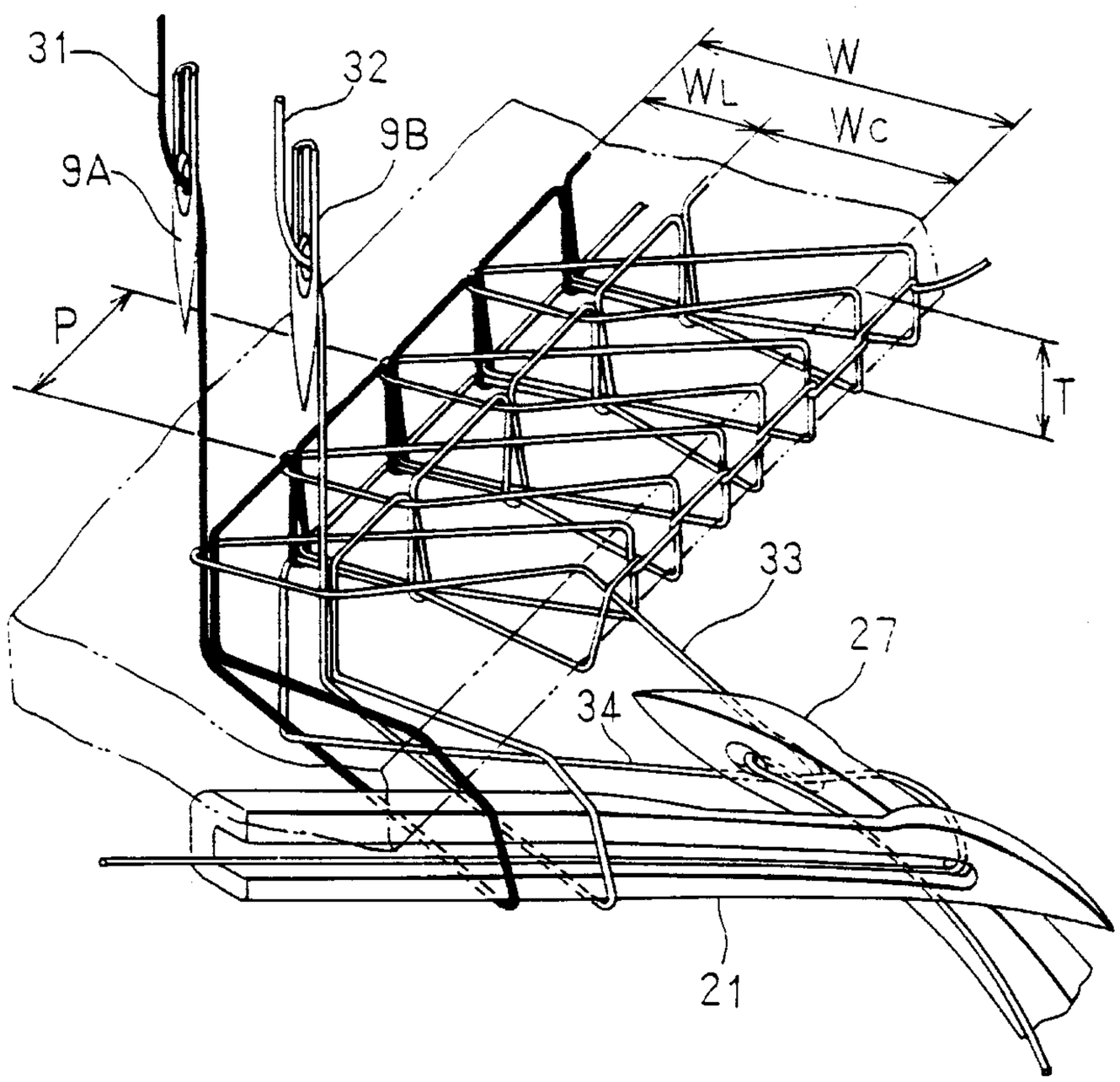


FIG.20

SINGLE NEEDLE OVERLOCK SEWING

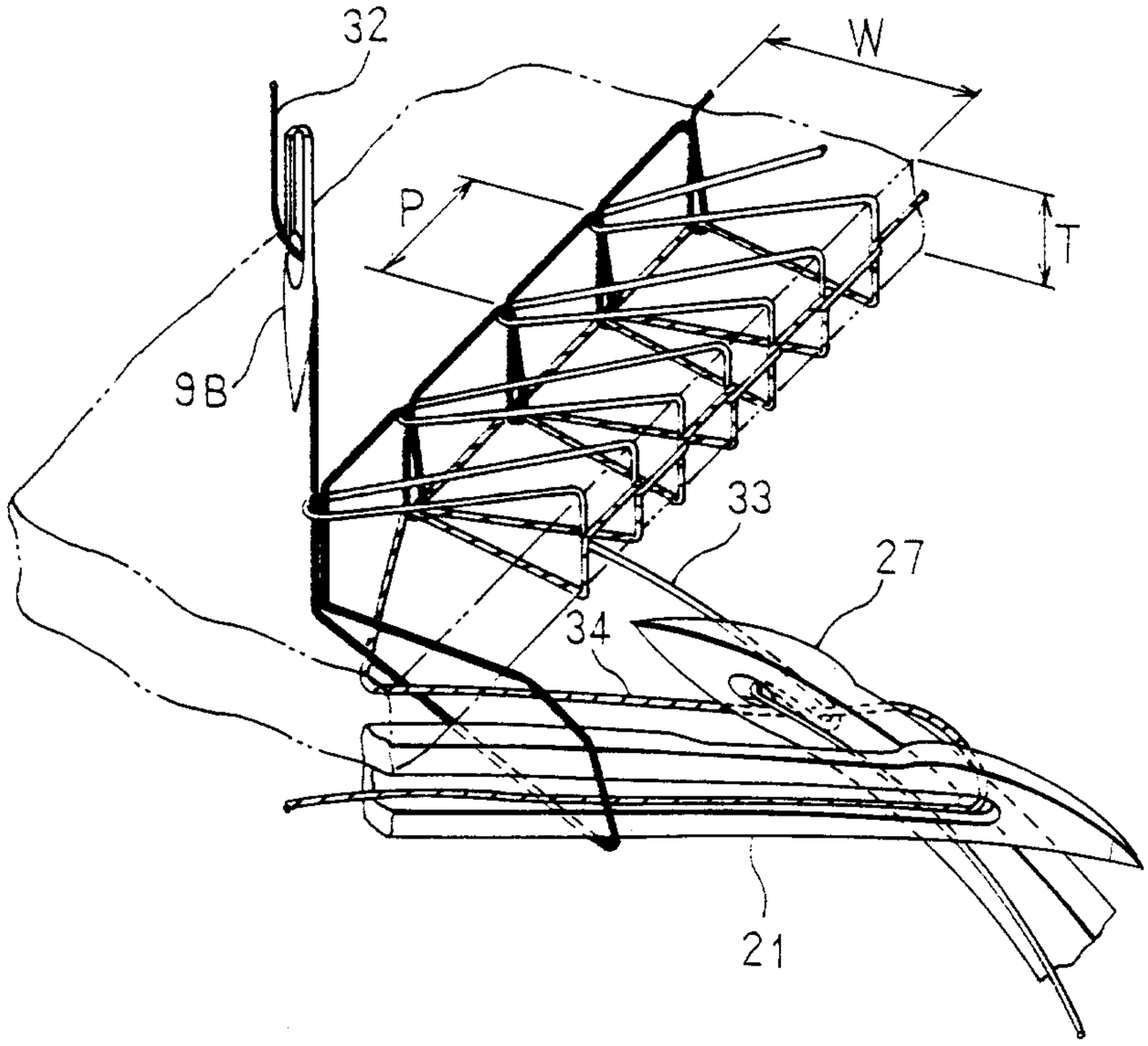


FIG.21
NARROW HEM SEWING

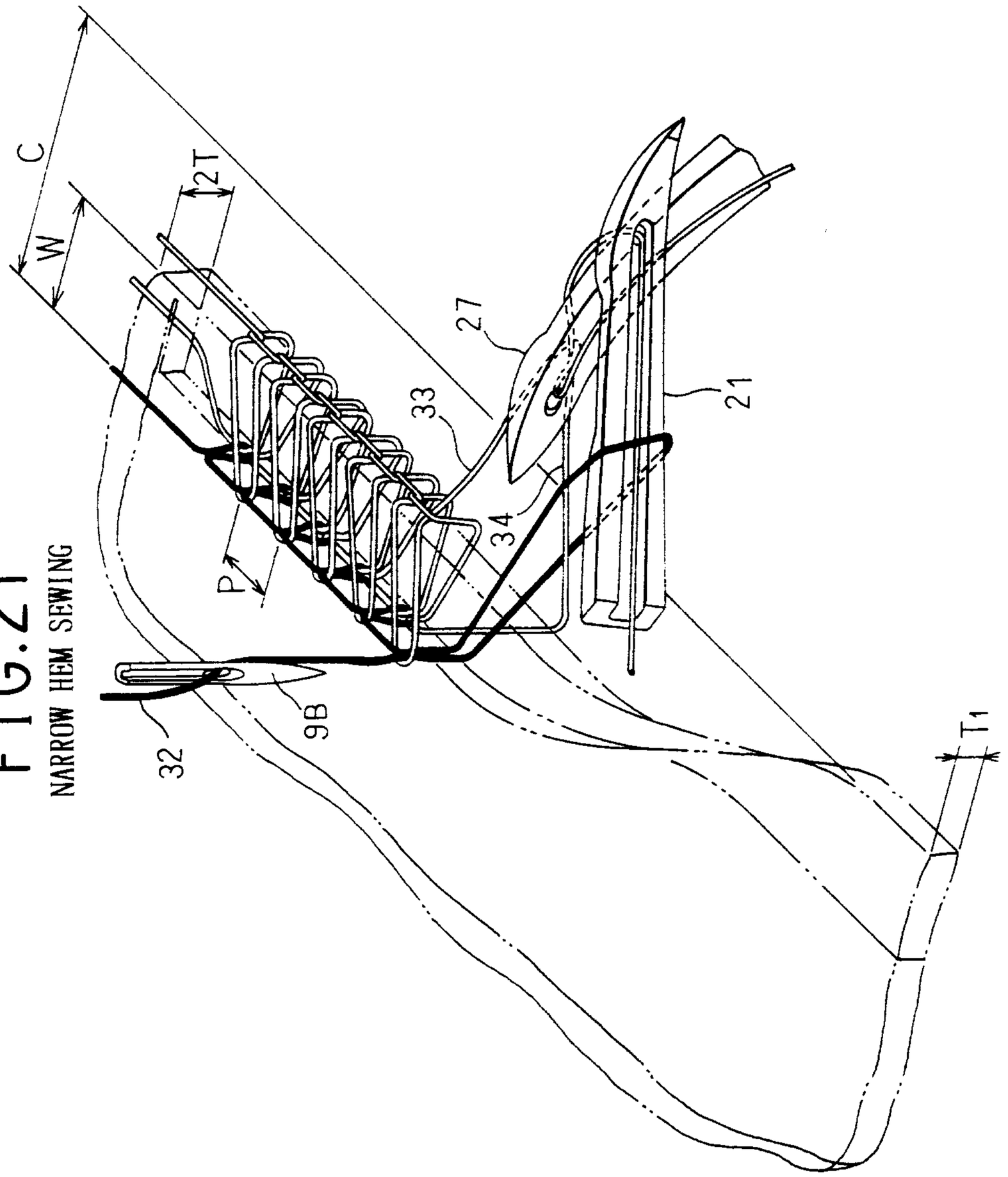
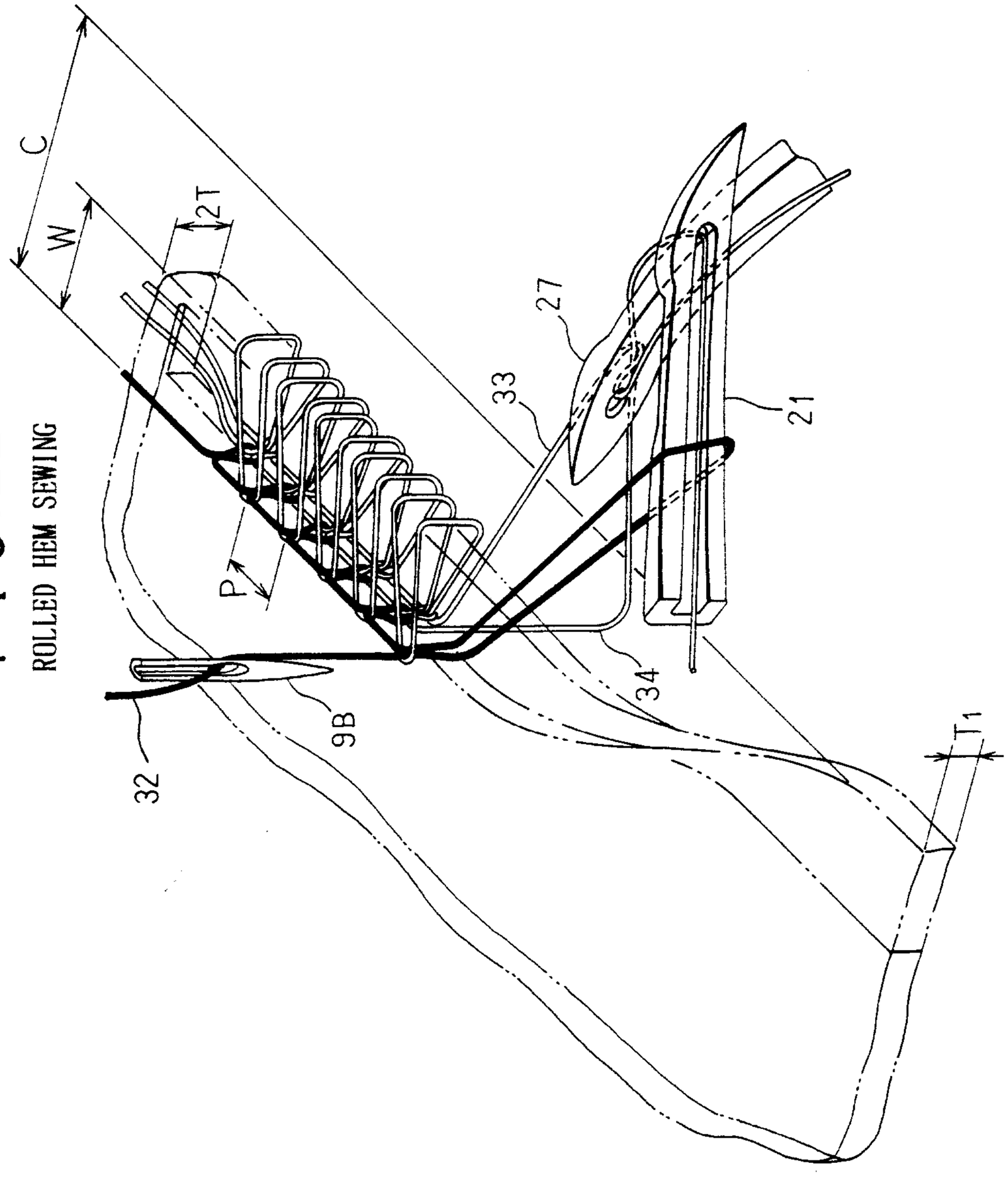


FIG.22
ROLLED HEM SEWING



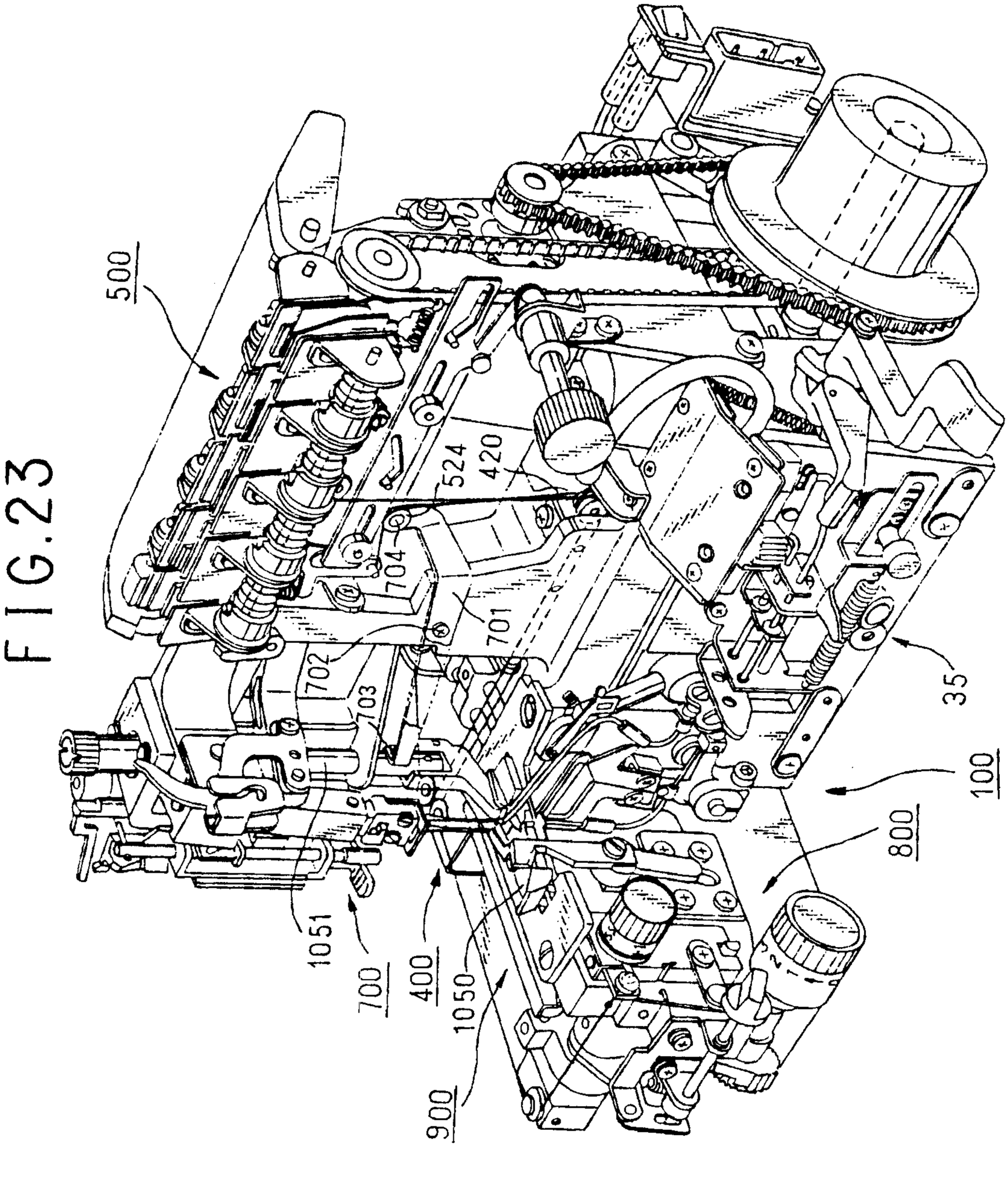
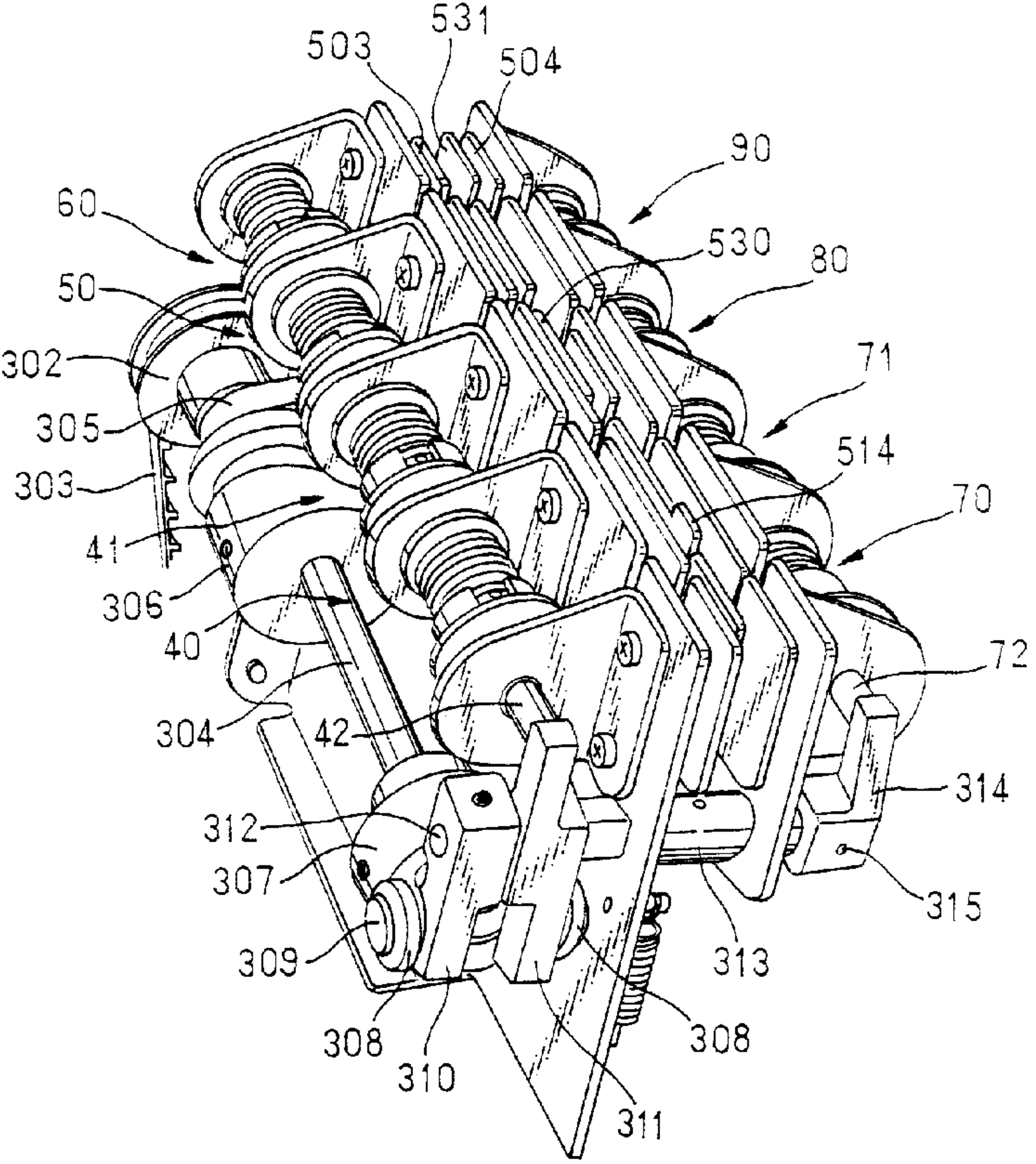


FIG.23


531
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504
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60
530
80
50
71
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305
514
303
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312
307
315
309
313
308
308
310
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