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(54) **SEQUIN FEEDER APPARATUS AND SEWING MACHINE CAPABLE OF SEWING SEQUINS**

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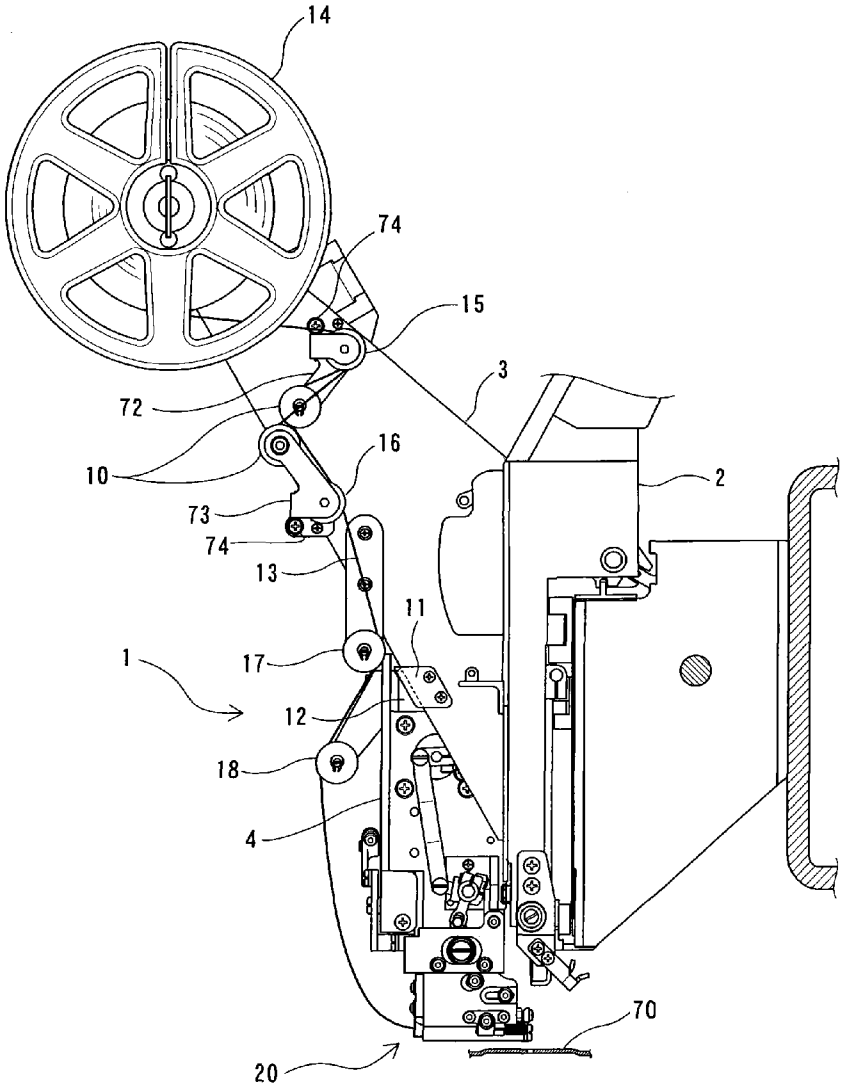
(57) **ABSTRACT**

Sequin feeder apparatus includes at least two sequin feed units each including a sequin feed mechanism for feeding a continuous sequin strip toward a predetermined cutting position and a sequin-cutting cutter section located in the predetermined cutting position. One of the sequin feed units is selected and positioned in a predetermined sewing operation position, and driving force of a feeding drive mechanism is transmitted to the sequin feed mechanism to feed out a sequin. Respective cutting positions of the cutter sections of the feed units are adjustable independently of each other.



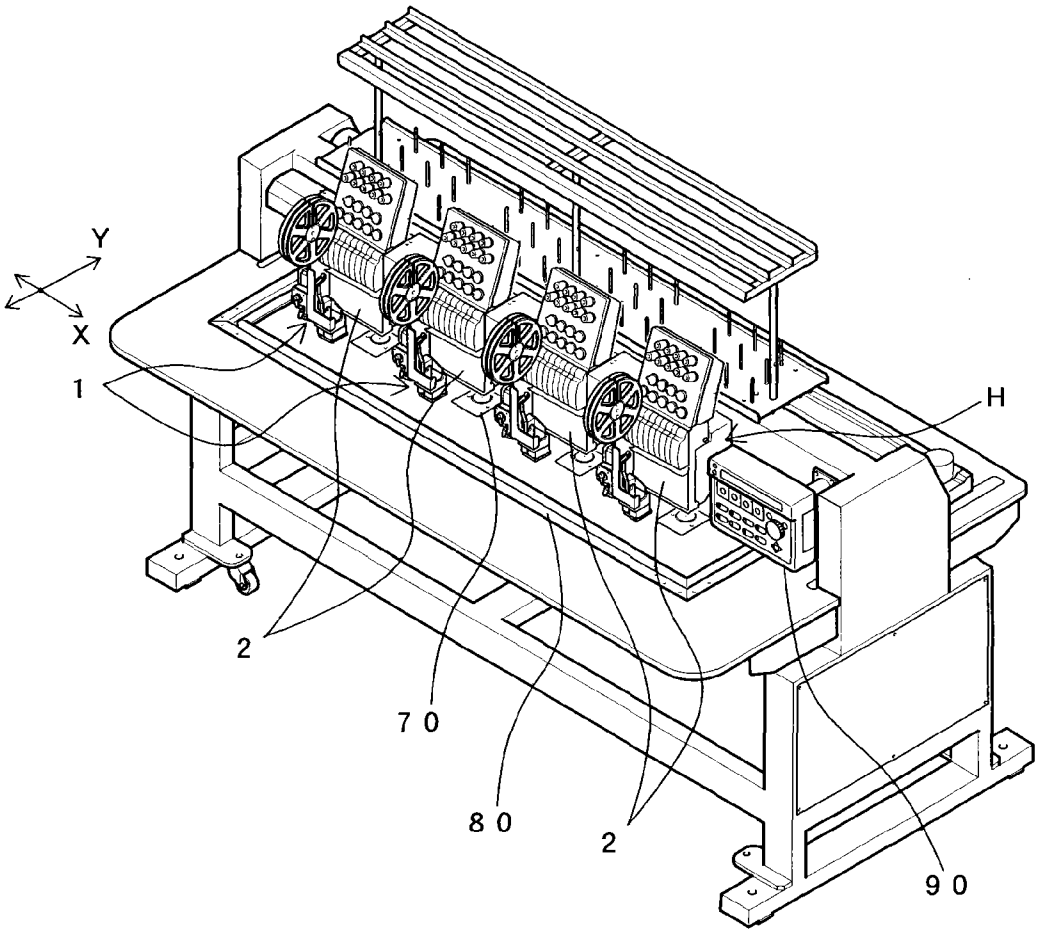


FIG. 1

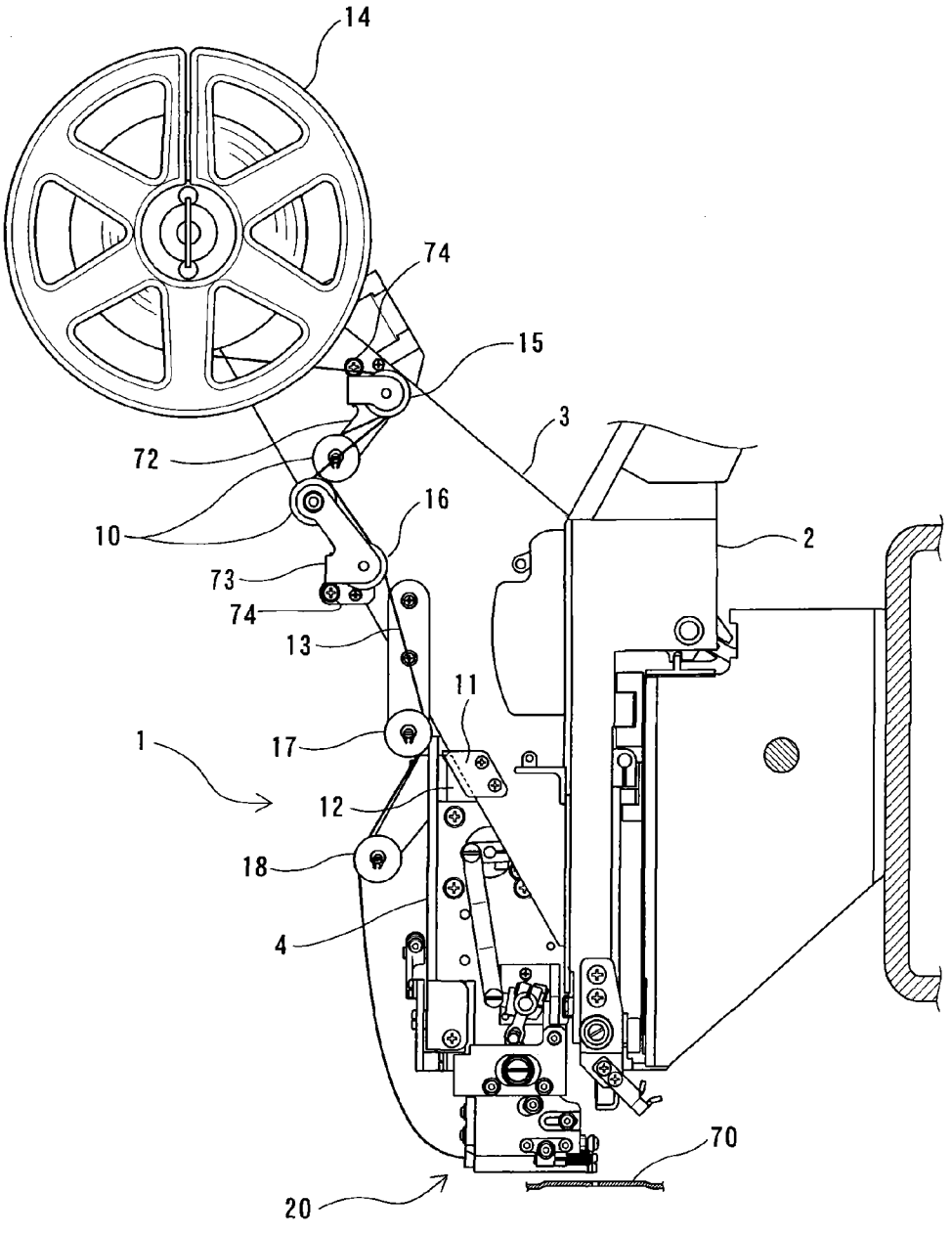


FIG. 2

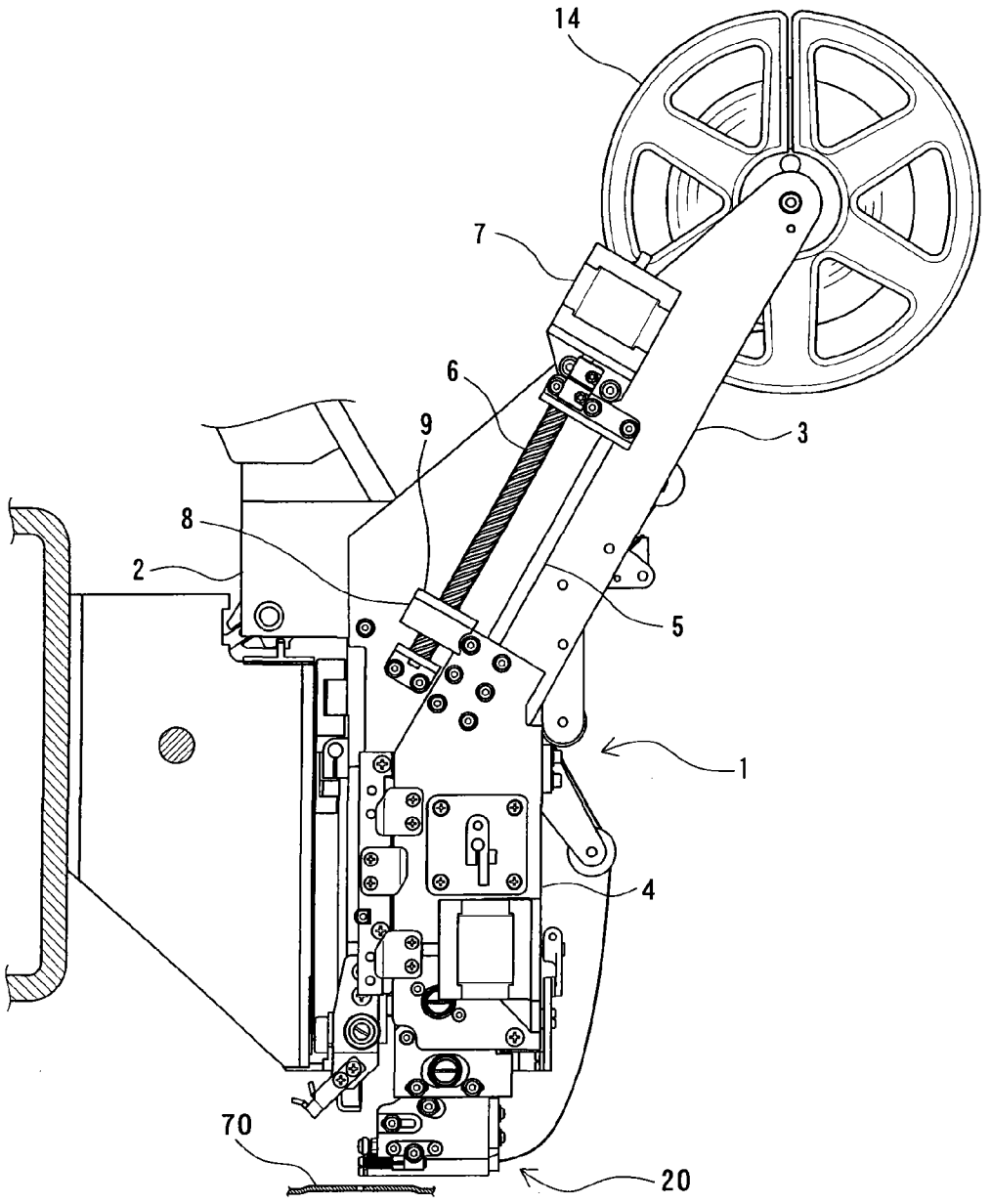


FIG. 3

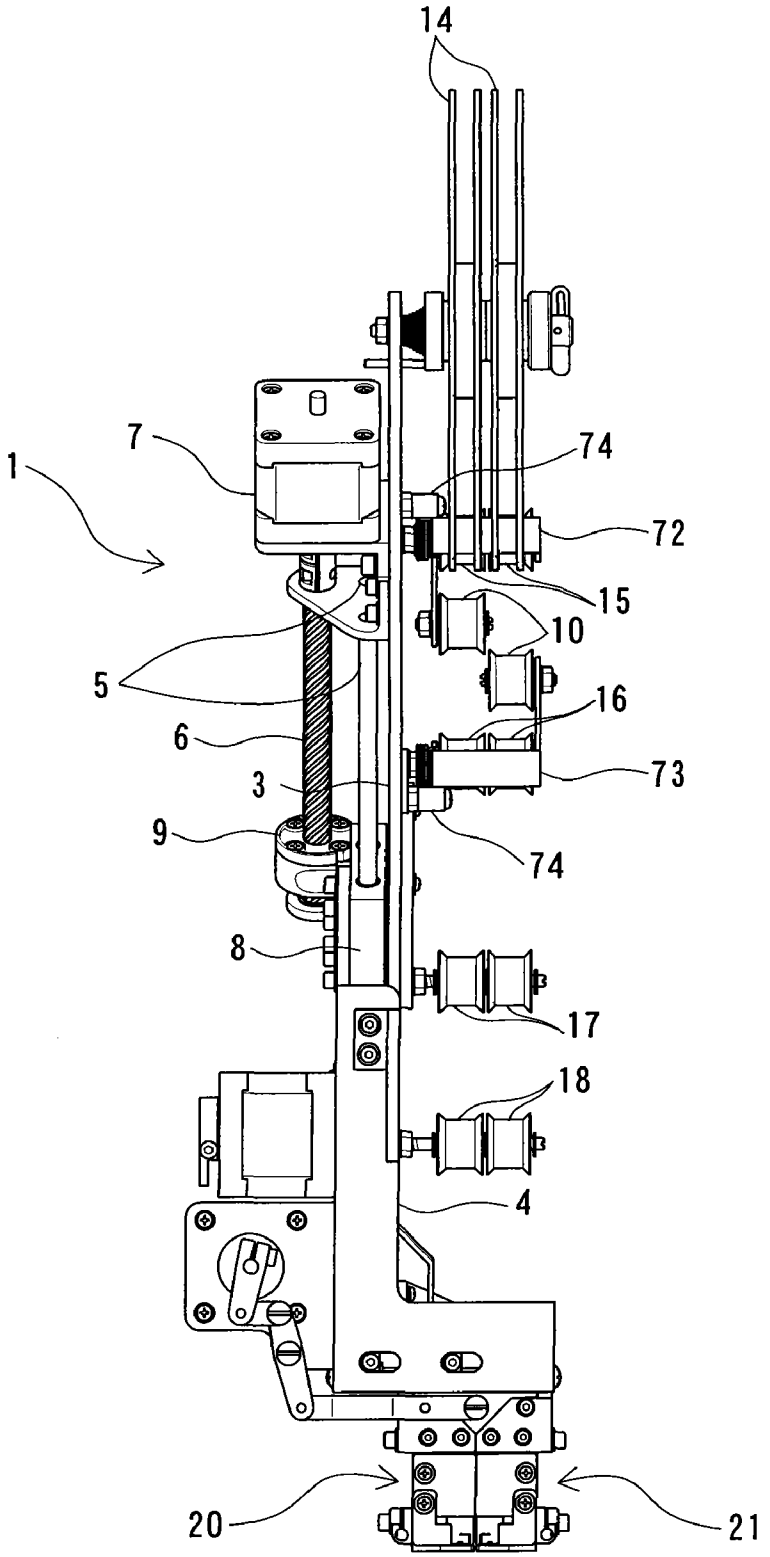


FIG. 4

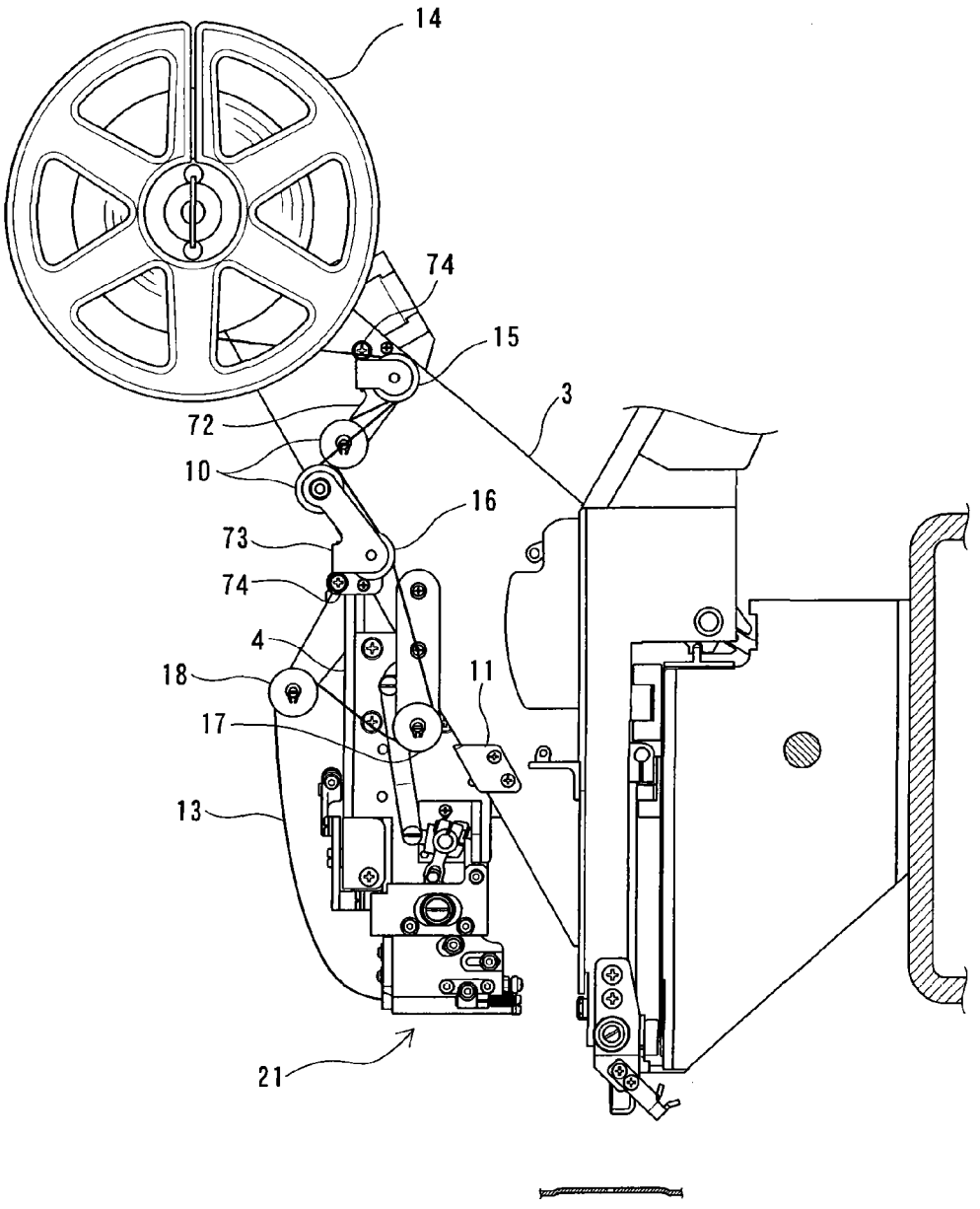


FIG. 5

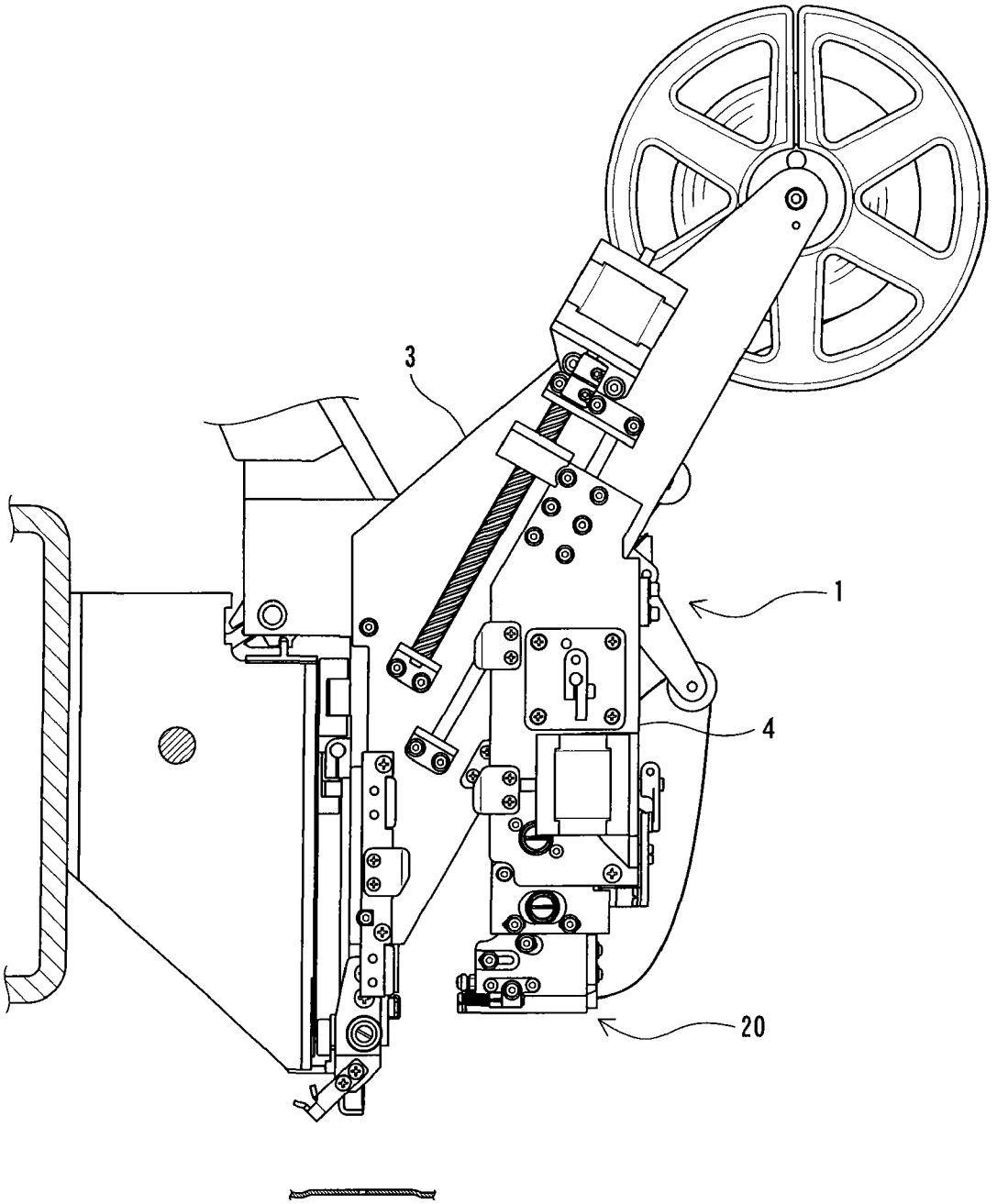


FIG. 6

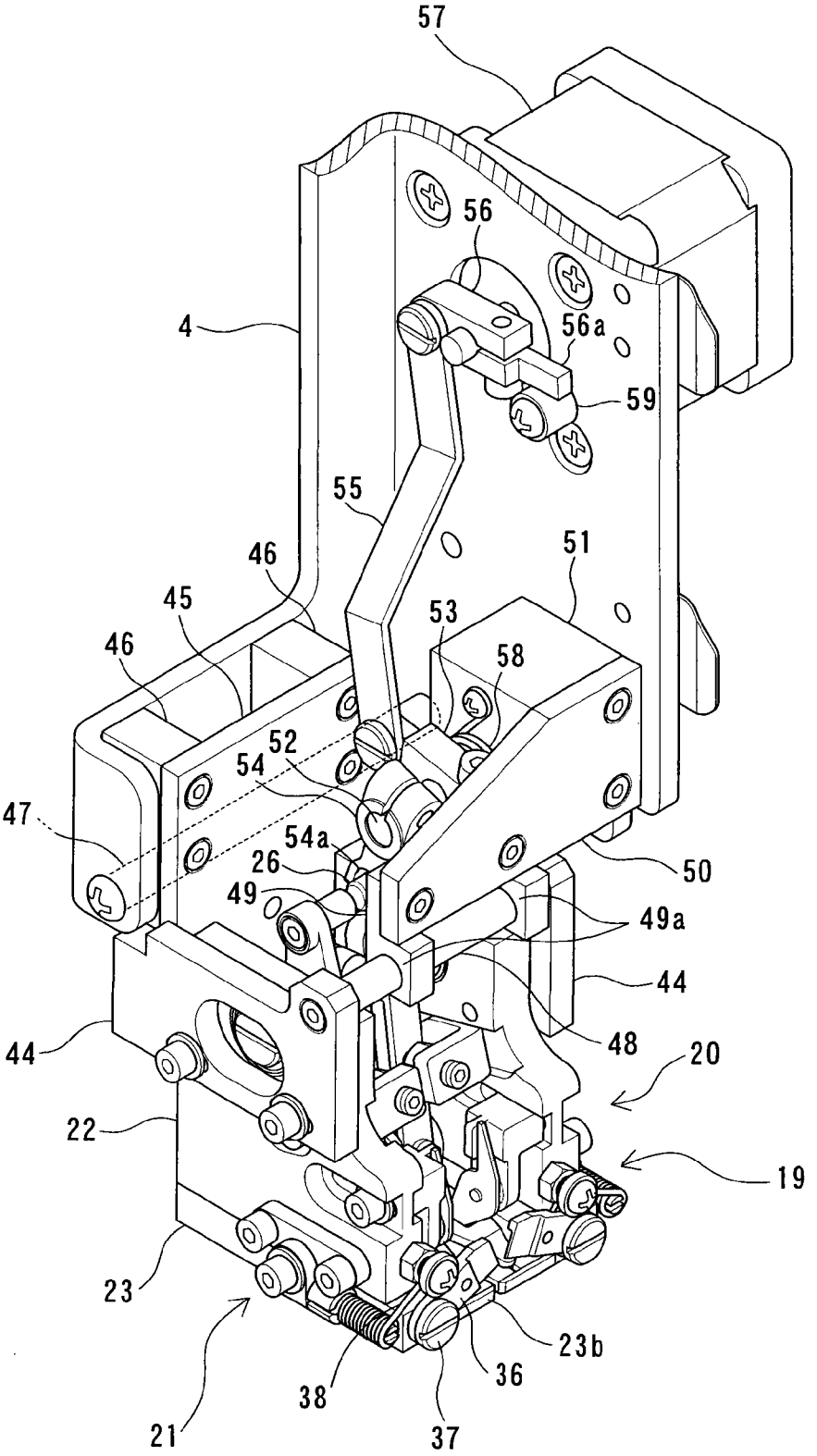

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FIG. 7

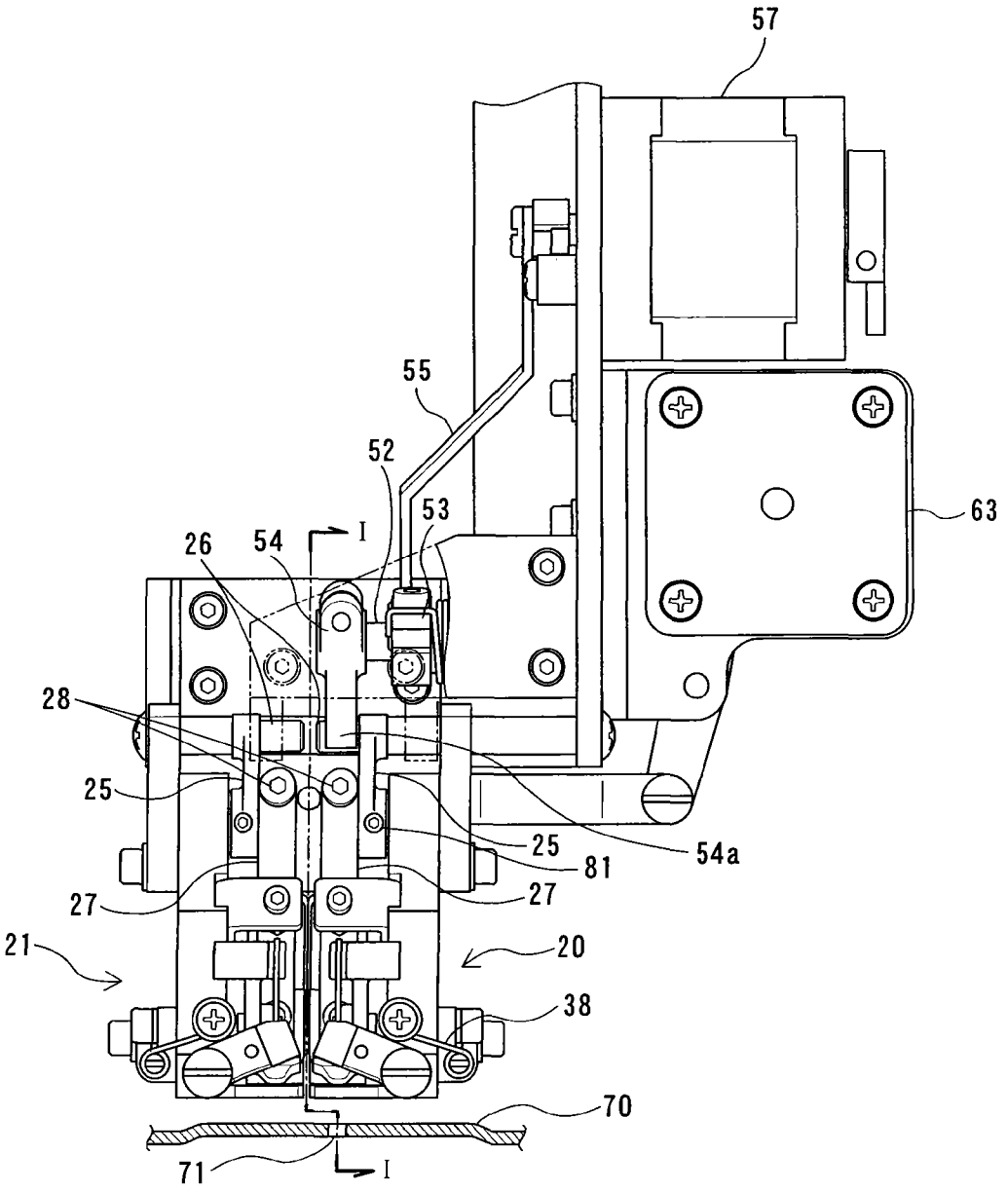

FIG. 8

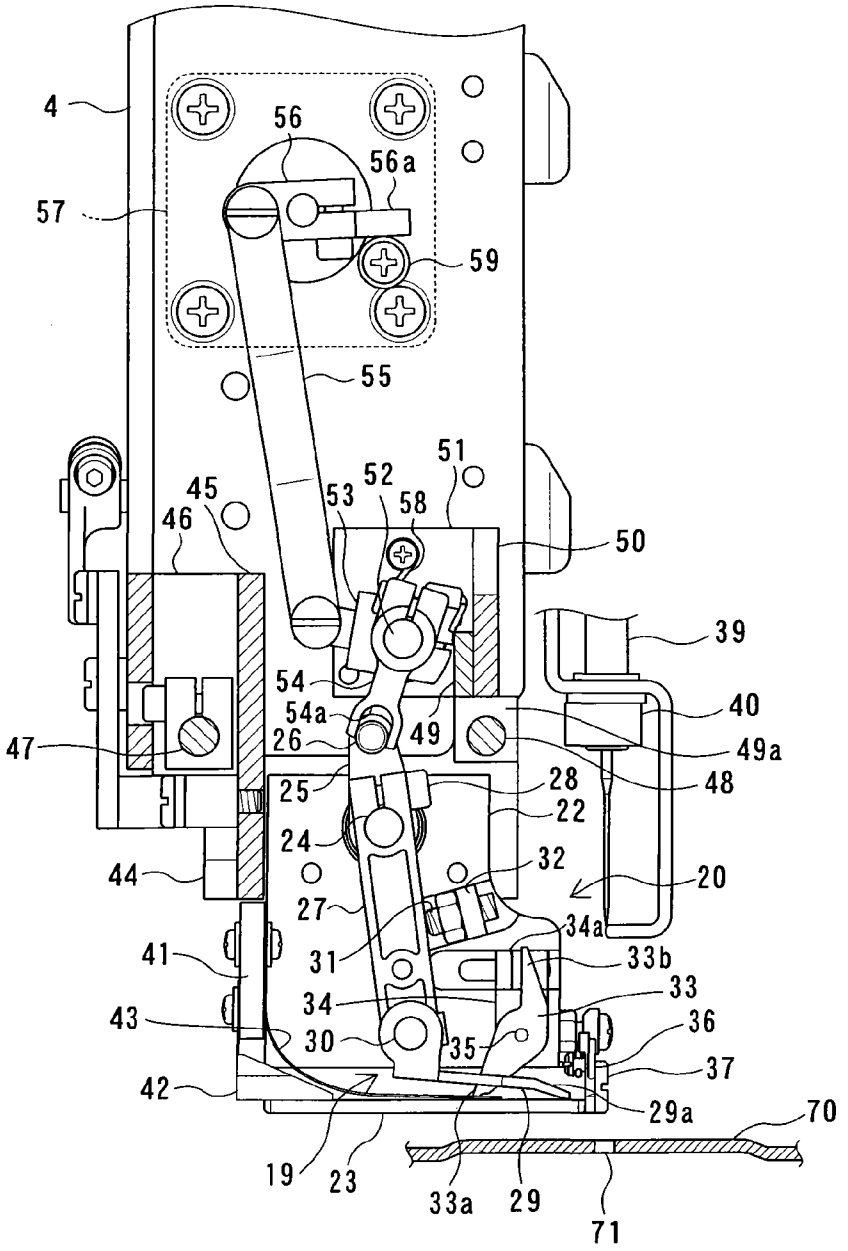
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FIG. 9

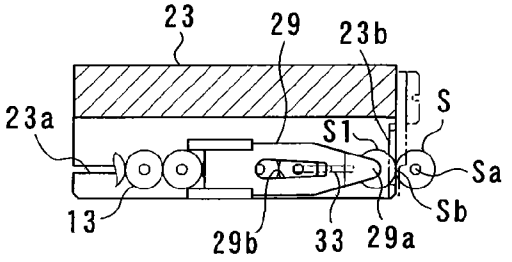
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FIG. 10

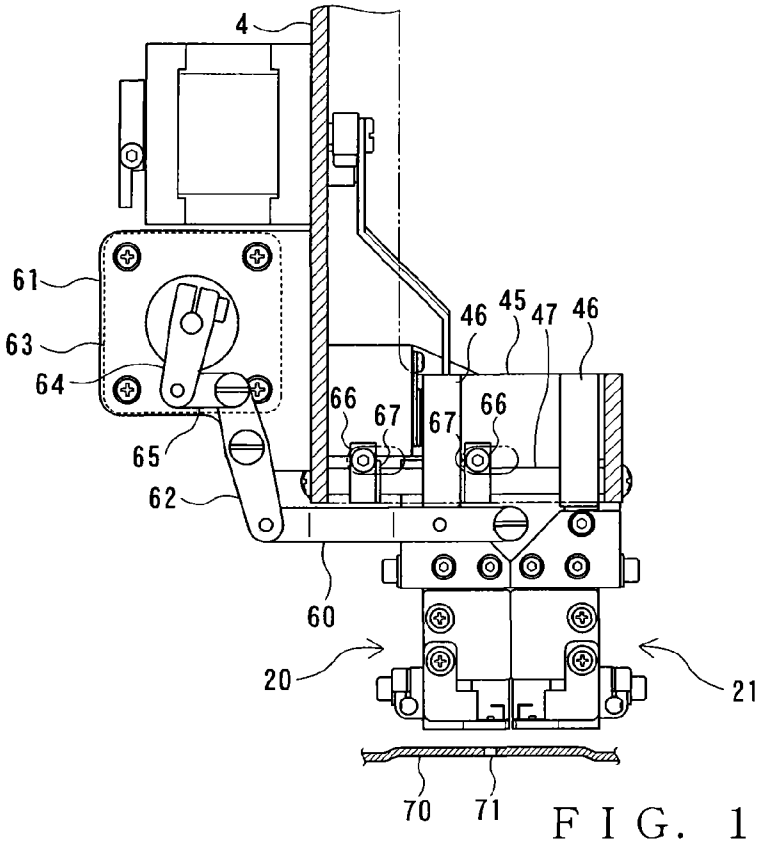
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FIG. 11

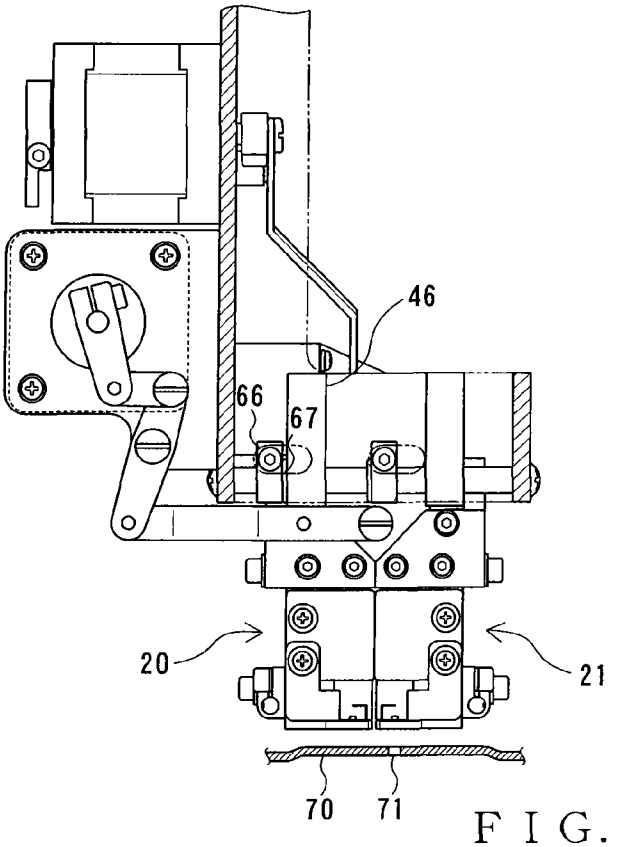
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FIG. 12

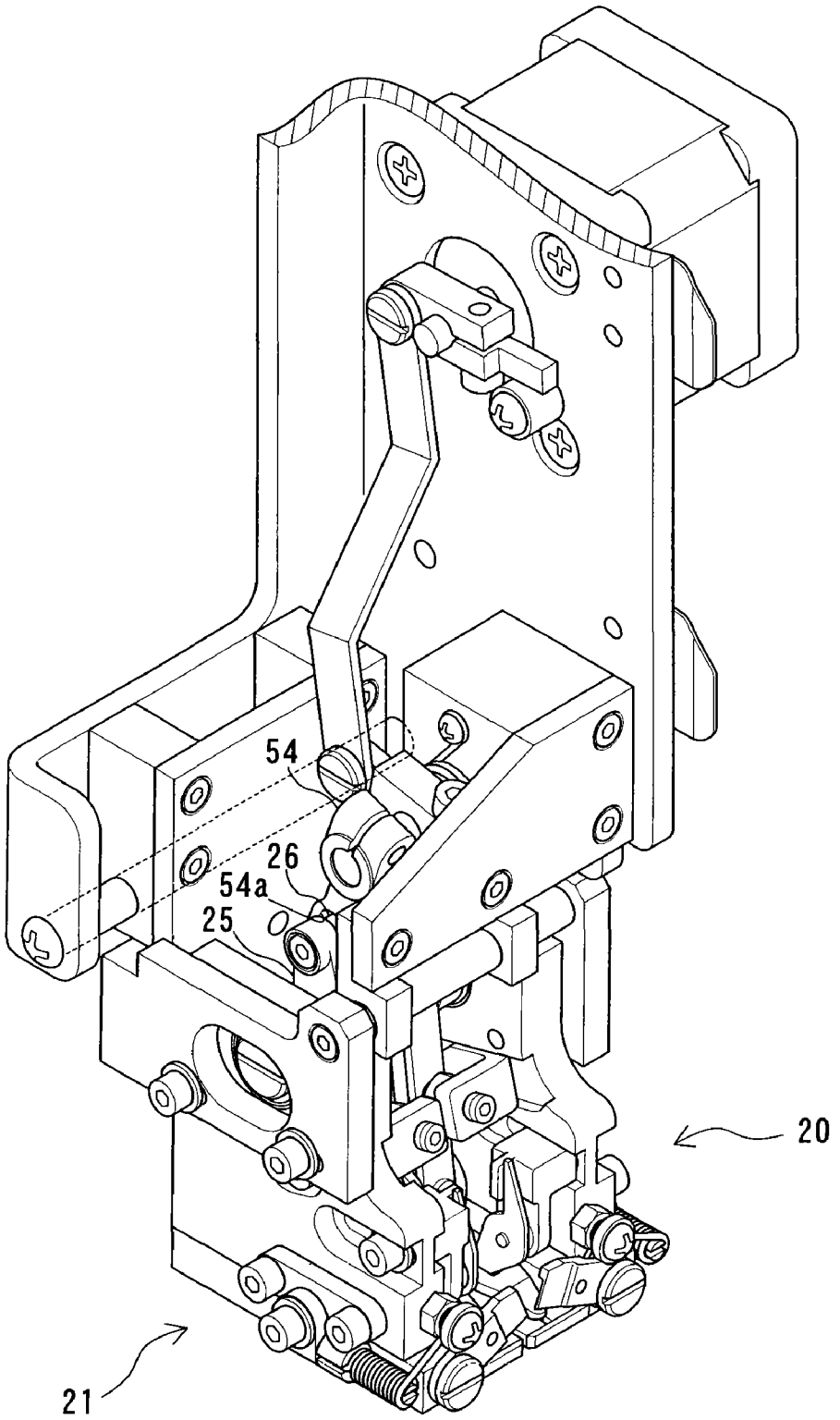

FIG. 13

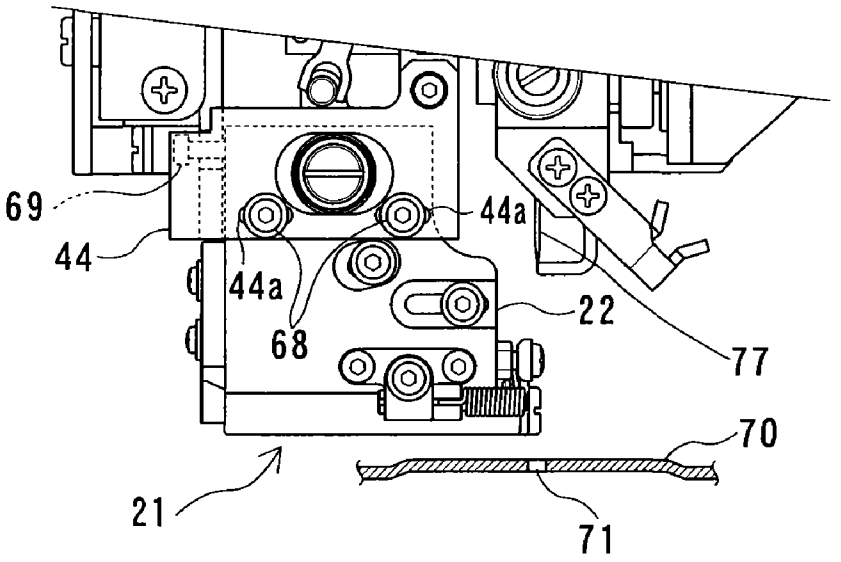

FIG. 14

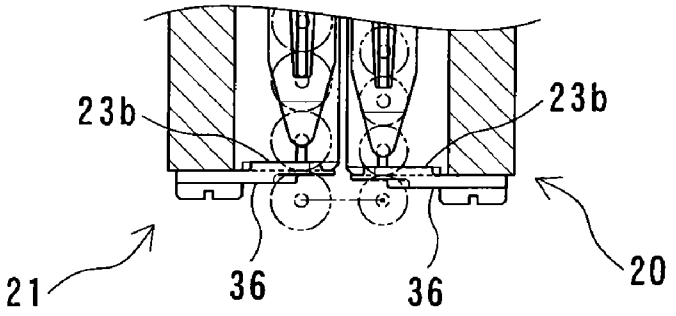

FIG. 15

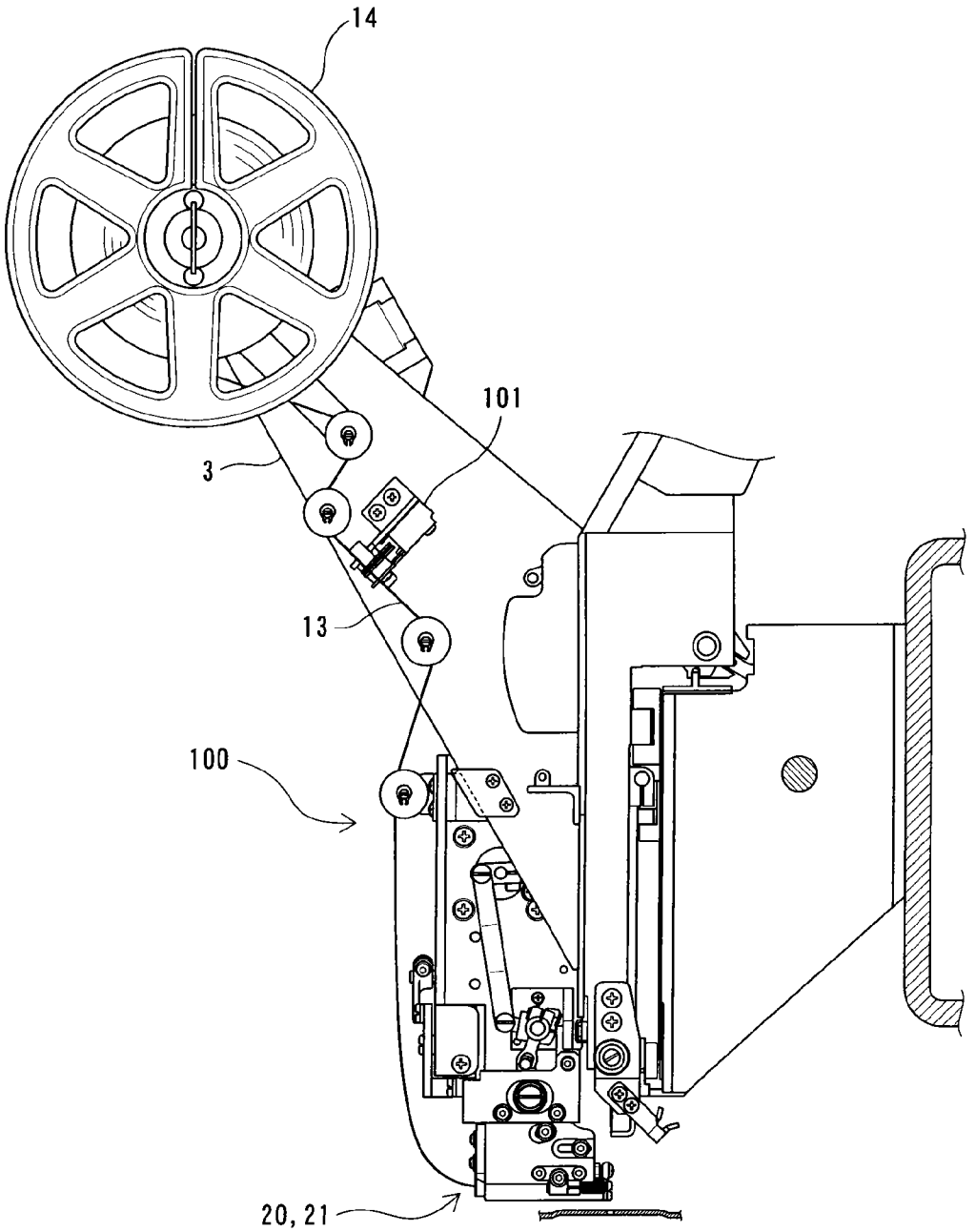

FIG. 16

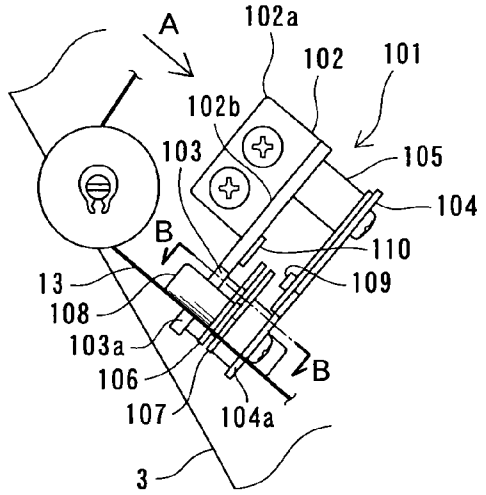

FIG. 17

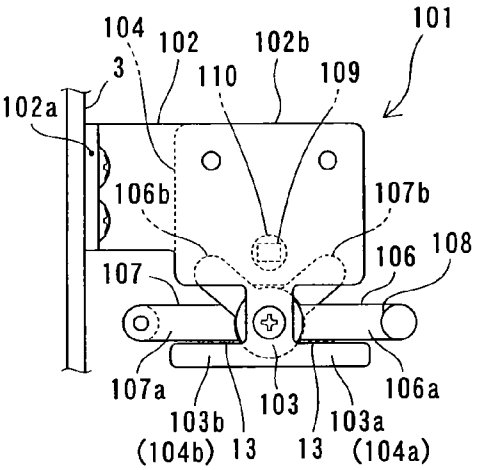

FIG. 18

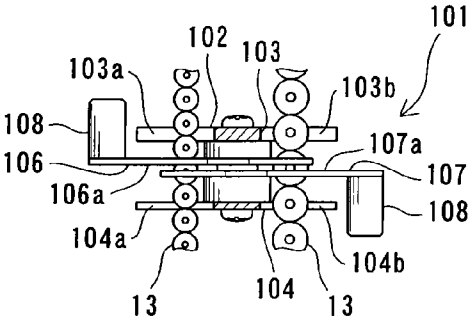

FIG. 19

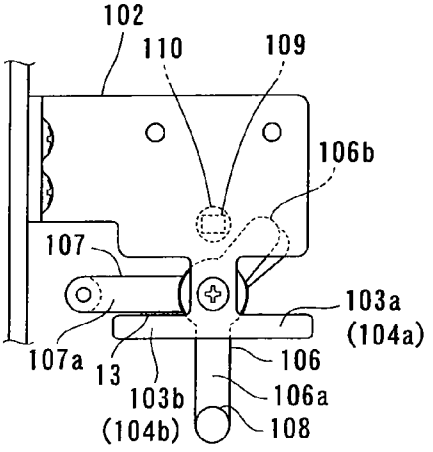

FIG. 20

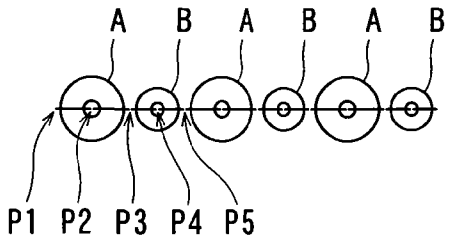

FIG. 21

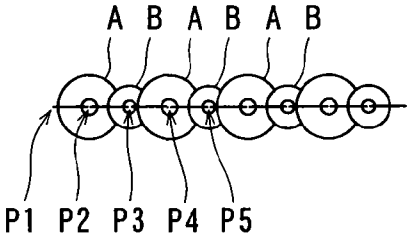

FIG. 22

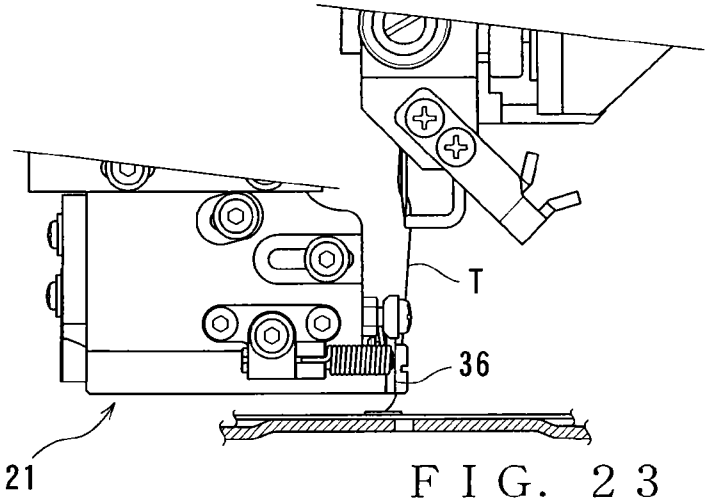

FIG. 23

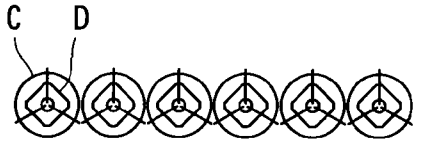

FIG. 24

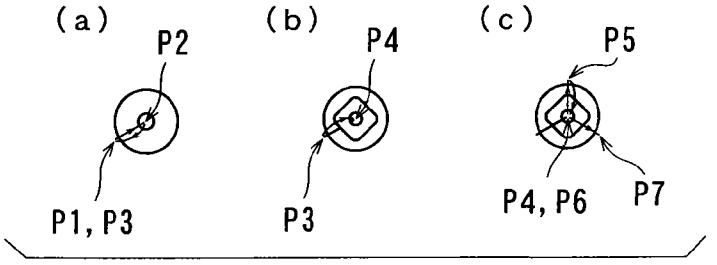

FIG. 25

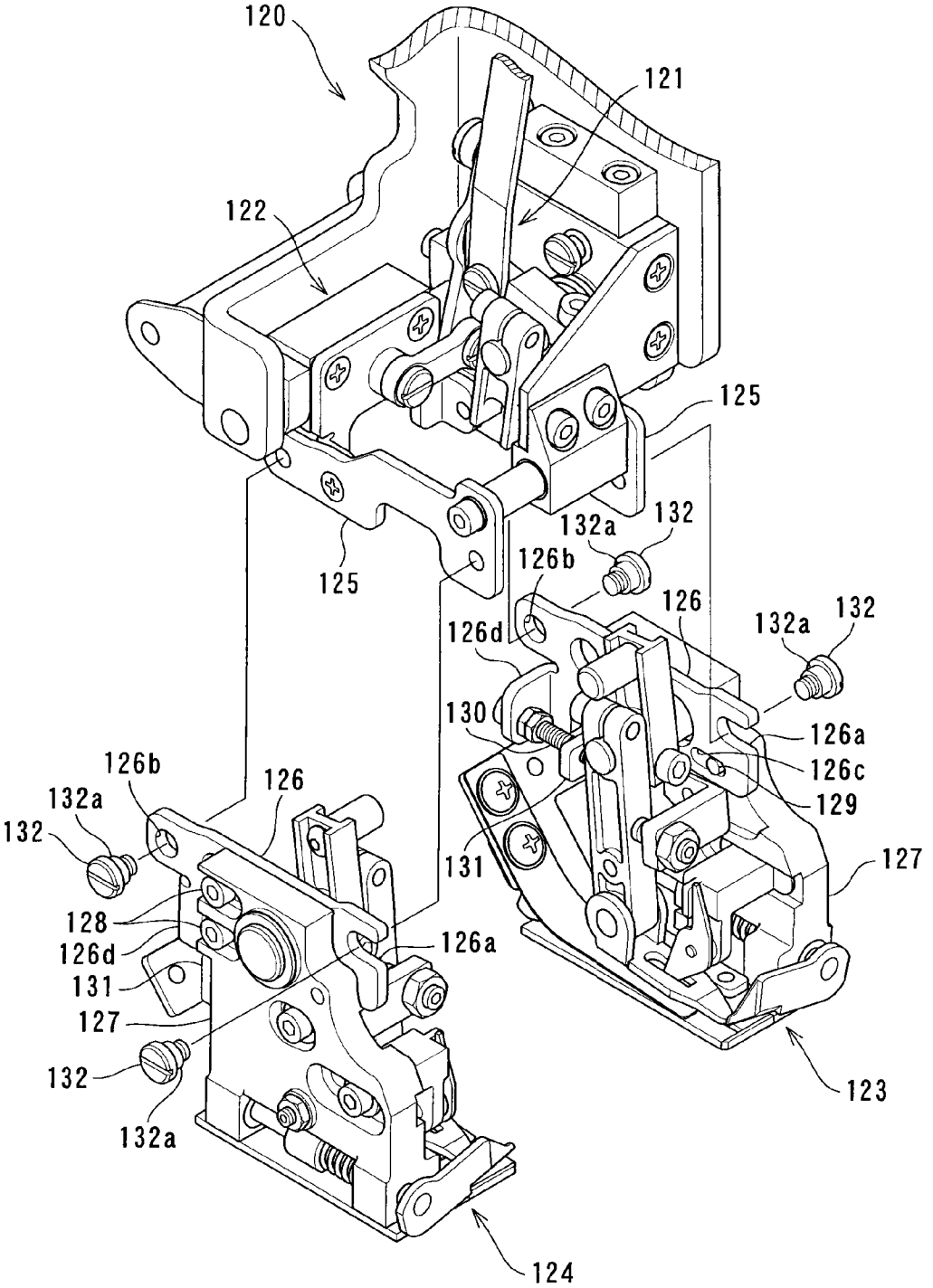
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FIG. 26

SEQUIN FEEDER APPARATUS AND SEWING MACHINE CAPABLE OF SEWING SEQUINS

BACKGROUND

[0001] The present invention relates generally to sequin feeder apparatus for use in sewing machines which sew a sequin onto a sewing workpiece while severing the sequin from a ribbon or strip of continuously-connected sequins. More particularly, the present invention relates to a sequin feeder apparatus which is capable of changing the sequin to be sewn from one type to another in the middle of sewing, as well as a sewing machine suited to sew sequins of different pitches in combination.

[0002] Example of the conventional sequin feeder apparatus is known from German Utility Model Registration No. G9209764.2, U.S. Pat. No. 5,755,168 or German Patent No. DE19538084 (corresponding to U.S. Pat. No. 5,755,168 above). Such a known sequin feeder apparatus includes a feed mechanism, which causes a strip of a multiplicity of continuously-connected sequins (or spangles) (hereinafter referred to as "continuous sequin strip") to be let out or paid out from a reel, having the continuous sequin strip wound thereon, onto a support plate and then, through predetermined forward and rearward (i.e., advancing and retracting) movement of a feed lever, feeds the continuous sequin strip at a predetermined pitch corresponding to the size of each sequin of the strip. One sequin is sewn at a time onto a sewing workpiece while being severed or cut off from the continuous sequin strip having been fed in interlocked relation to a sewing operation by a needle bar of the sewing machine.

[0003] Further, Japanese Patent Application Laid-open Publication No. 2004-167097 discloses an embroidery sewing machine including a sequin feeder apparatus attached to a sewing head so that sequins can be sewn onto a sewing workpiece, such as an embroidering fabric.

[0004] Furthermore, Korean Patent Application Laid-open Publication No. 10-2006-68405 and Korean Patent Publication No. 10-614630 (corresponding to the No. 10-2006-68405 laid-open publication) disclose an apparatus capable of changing or switching the sequin to be sewn to from one type to another in the middle of sewing. The disclosed apparatus includes two sequin reels each having wound thereon a different strip of continuously-connected sequins of a predetermined shape and color, and feeding rods for individually feeding out the respective continuous sequin strips, paid out from the reels, to a needle entry point. By selecting the feeding-out operation by any one of the feeding rods on the basis of a control signal, the disclosed apparatus can successively perform sequin sewing while switching between the continuous sequin strips to be fed toward the needle entry point. However, the disclosed apparatus is provided with only one, common cutter section for cutting a sequin off from any one of the sequin strips; namely, a sequin of one of the continuous sequin strips, which has been fed out by the corresponding feeding rod, is cut off by the common cutter section. Therefore, although sequins can be made different in size between two continuous sequin strips to be set on the reels, the sequin sizes can no longer be changed freely once continuous sequin strips having sequins of predetermined sizes are set. Because, the common cutter section, shared between the two continuous sequin strips, comprises a movable cutter blade having a predetermined stepped structure and a fixed cutter blade (or die) having a similar predetermined stepped structure, and the stepped structures of these movable and fixed cutter blades have to be mechanically fixed. Namely, if the apparatus is constructed so that continuous sequin strips of different sequin sizes are set on the two reels, the mechanically-fixed structures of the common cutter section can not deal with the different sequin sizes.

SUMMARY OF THE INVENTION

[0005] In view of the foregoing, it is an object of the present invention to provide an improved sequin feeder apparatus which includes a plurality of sequin feed units such that the sequin to be sewn can be changed from one type to another in the middle of sewing and which allows a sequin feed amount of each of the sequin feed units to be changed as desired. It is another object of the present invention to provide an improved sewing machine which is suited to sew sequins of desired different feed pitches in combination using such an improved sequin feeder apparatus.

[0006] According to one aspect of the present invention, there is provided a sequin feeder apparatus, which comprises: at least two sequin feed units each including a sequin feed mechanism for feeding a continuous sequin strip toward a predetermined cutting position and a sequin-cutting cutter section located in the predetermined cutting position; a sequin selection mechanism for selecting one of the at least two sequin feed units and positioning the selected one sequin feed unit in a predetermined sewing operation position; and a drive mechanism for engaging with the sequin feed mechanism of the one sequin feed unit, positioned in the predetermined sewing operation position, and thereby driving, in response to a sewing operation, the engaged sequin feed mechanism to feed the continuous sequin strip toward the predetermined cutting position. Here, the predetermined cutting position in each of the sequin feed units is adjustable independently of the predetermined cutting position in the other sequin feed unit, and the cutter section is driven, in response to the sewing operation, to cut a sequin off from the continuous sequin strip having been fed to the predetermined cutting position.

[0007] According to another aspect of the present invention, there is provided a sewing machine where the aforementioned sequin feeder apparatus of the present invention is provided in association with a sewing head.

[0008] Each of the sequin feed units includes its own sequin feed mechanism and sequin-cutting cutter section, and the predetermined cutting position in each of the sequin feed units is adjustable independently of the predetermined cutting position in the other sequin feed unit. Thus, in each of the sequin feed units, the cutting position, where the cutter section cuts a sequin off from the sequin strip, can be adjusted as desired independently of the cutting position in the other sequin feed unit; thus, the sequin feed units can respectively handle sequins of desired feed sizes. Because the present invention thus arranged allows a sequin feed amount of the continuous sequin strip in each of the feed units to be changed as desired independently of the sequin feed amount in the other feed unit, the sewing machine, to which is applied the sequin feeder apparatus of the present invention, can perform sequin sewing while combining sequins of desired different feed pitches.

[0009] The following will describe embodiments of the present invention, but it should be appreciated that the

present invention is not limited to the described embodiments and various modifications of the invention are possible without departing from the basic principles. The scope of the present invention is therefore to be determined solely by the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a perspective view showing a general outer appearance of an embroidery sewing machine to which is applied a sequin feeder apparatus of the present invention;

[0011] FIG. **2** is a right side view showing a first embodiment of the sequin feeder apparatus of the present invention, which particularly shows the sequin feeder apparatus held in a lowered position;

[0012] FIG. **3** is a left side view of the first embodiment of the sequin feeder apparatus;

[0013] FIG. **4** is a front view of the first embodiment of the sequin feeder apparatus;

[0014] FIG. **5** is a right side view of the first embodiment of the sequin feeder apparatus, which particularly shows the sequin feeder apparatus held in an evacuated position;

[0015] FIG. **6** is a left side view of the first embodiment of the sequin feeder apparatus, which shows the sequin feeder apparatus held in the evacuated position;

[0016] FIG. **7** is a rear perspective view showing in enlarged scale parts of sequin feed units, sequin selection mechanism and feeding drive mechanism in the first embodiment of the sequin feeder apparatus;

[0017] FIG. **8** is a rear view of the first embodiment of the sequin feeder apparatus;

[0018] FIG. **9** is a sectional view taken along the I-I line of FIG. **8**;

[0019] FIG. **10** is a plan view showing a manner in which a leading sequin is cut off from a continuous sequin strip held on a support plate in one of the sequin feed units in the first embodiment;

[0020] FIG. **11** is a front view showing in enlarged scale parts of the sequin feed units and sequin selection mechanism when where the first sequin feed unit is selected;

[0021] FIG. **12** is a front view showing in enlarged scale parts of the sequin feed units and sequin selection mechanism when the second sequin feed unit is being selected;

[0022] FIG. **13** is a perspective view similar to FIG. **7**, which shows parts of the sequin feed units, sequin selection mechanism and feeding drive mechanism when the second sequin feed unit is selected;

[0023] FIG. **14** is a side view of a supporting plate of the second sequin feed unit taken from a side opposite a side where the sequin feed mechanism is disposed;

[0024] FIG. **15** is a sectional plan view showing a manner in which respective cutting positions of the first and second feed units are adjusted in accordance with sequin sizes of continuous sequin strips set on the feed units;

[0025] FIG. **16** is a right side view of a second embodiment of the sequin feeder apparatus;

[0026] FIG. **17** is a right side view showing in enlarged scale a detection device employed in the second embodiment;

[0027] FIG. **18** is a view taken in a direction of arrow A of FIG. **17**;

[0028] FIG. **19** is a sectional view taken along the B-B line of FIG. **17**;

[0029] FIG. **20** is a view showing a state where a supply of one of continuous sequin strips has run out;

[0030] FIG. **21** is a view showing an example of a sequin pattern to be made by alternately sewing sequins of different types to a workpiece;

[0031] FIG. **22** is a view showing another example of the sequin pattern to be made by alternately sewing sequins of different types to a workpiece;

[0032] FIG. **23** is a side view showing a state where a previous-sewn stitch position has got into under the sequin feed unit;

[0033] FIG. **24** is a view showing an example of a sequin pattern to be by alternately sewing sequins of different types to a workpiece in overlapped relation to each other;

[0034] FIG. **25** is a view showing an example sequence of operations for sewing the sequin pattern, comprising two sequins of different types, to the workpiece in overlapped relation to each other; and

[0035] FIG. **26** is an exploded rear perspective view of a sequin feeder apparatus in accordance with another embodiment of the present invention.

DETAILED DESCRIPTION

[0036] FIG. **1** shows a four-head embroidery sewing machine equipped with four sewing machine heads H. Needle bar cases **2** are provided in corresponding relation to the sewing machine heads H, and a needle plate **70** is disposed under each of the needle bar cases **2**. Sequin feeder apparatus **1** is attached to the left side and/or right side of each of the needle bar cases **2**; in the instant embodiment, the sequin feeder apparatus **1** is attached to only the left side of each of the needle bar cases **2**. Each of the needle bar cases **2** comprises a multi-needle structure, and, in the case where the sequin feeder apparatus **1** is attached to the left side of the associated needle bar case **2** as in the illustrated example, the leftmost needle bar in the needle bar case **2** is used as a sequin sewing needle bar (or sequin needle bar). As conventionally known in the art, an embroidery frame **80** is driven in left-right (X) and front-rear (Y) horizontal directions in accordance with predetermined sewing data.

First Embodiment

[0037] First, a description will be given about a first embodiment of the sequin feeder apparatus **1**.

[0038] FIG. **2** is a right side view showing in enlarged scale a part of one of the sequin feeder apparatus **1**, FIG. **3** is a left side view of the sequin feeder apparatus **1**, and FIG. **4** is a front view of the sequin feeder apparatus **1**. The sequin feeder apparatus **1** includes a fixed base **3** fixed to the left side surface of the needle bar case **2** for attaching the feeder apparatus **1** to the machine head H, and a mounting base **4** mounted on the fixed base **3** in such a manner that it can ascend and descend relative to the fixed base **3**. Two guide rods **5** are fixed to the base **3**, and a screw shaft **6** is pivotally mounted on the base **3**; note that, in FIG. **3**, only one of the guide rods **5** is shown with the other guide rod **5** located behind the screw shaft **6** and thus invisible in FIG. **3**. The screw shaft **6** is connected to the shaft of a motor **7** fixed to the base **3**. Moving member **8** slidably fitted on the two guide rods **5** is fixed to the mounting base **4**. Nut member **9** screwed on the screw shaft **6** is fixed to the moving member **8**. Thus, as the screw shaft **6** rotates by being driven via the motor **7**, the mounting base **4** is vertically movable, along the guide rods **5**, between a lowered position in which the sequin feeder apparatus **1** performs a sequin sewing opera-

tion and an evacuated position in which the sequin feeder apparatus **1** does not perform a sequin sewing operation. FIGS. **2** and **3** show a state of the apparatus when the sequin feeder apparatus **1** is in the lowered position, and FIGS. **5** and **6** show a state of the apparatus when the sequin feeder apparatus **1** is in the evacuated position. Further, a positioning block **12** is fixed to the mounting base **4**, and, when the mounting base **4** is in the lowered position, this positioning block **12** fits between two positioning plates **11** having respective distal end portions that project along and are fixed to left and right surfaces of the base **3**. With the positioning block **12** fitting between the two positioning plates **11**, the mounting base **4** in the lowered position is positioned in the left-right horizontal direction.

[0039] Each of the sequin feeder apparatus **1** generally comprises: two sequin feed units **20** and **21**; a sequin selection mechanism (composed of components **44-50**, **60-67** and the like that will be later described with reference to FIG. **7** etc.) for selecting any one of the two sequin feed units **20** and **21** and positioning the selected sequin feed unit **20** or **21** in a predetermined sewing operation position; and a feeding drive mechanism (composed of components **51-59** and the like that will be later described with reference to FIG. **7** etc.) for engaging with a sequin feed mechanism **19** of the one sequin feed unit **20** or **21** positioned in the predetermined sewing operation position. These two sequin feed units **20** and **21**, sequin selection mechanism (**44-50**, **60-67** and the like) and feeding drive mechanism (composed of components **51-59** and the like) are mounted on the above-mentioned mounting base **4** so that they are vertically movable (ascendable and descendable) between an evacuated position for not performing sequin sewing and a lowered position for performing sequin sewing.

[0040] Further, each of the sequin feed units **20** and **21** includes the sequin feed mechanism **19** for feeding a continuous sequin strip **13** toward a predetermined cutting position, and a sequin-cutting cutter section (composed of components **36** and **23***b* that will be later described with reference to FIG. **7** etc.) located in the predetermined cutting position. As shown in FIG. **4**, two reels (sequin holder sections or sequin strip supply sources) **14**, each having a desired continuous sequin strip **13** wound thereon, are provided, in corresponding relation to the sequin feed units **20** and **21**, for feeding the continuous sequin strips **13** to the corresponding sequin feed units **20** and **21**. Each of the reels **14** corresponding to the sequin feed units **20** and **21** holds, i.e. has wound thereon, the continuous sequin strip **13** comprising a multiplicity of continuously-connected sequins each having a desired shape, color and size (i.e., feed size corresponding to a dimension from the needle-passing hole to the outer periphery of the sequin). Namely, the instant embodiment is capable of using one sequin feeder apparatus **1** to sew a combination of two different types of sequins as sequins to be sewn to make an embroidery pattern. Two reels (sequin strip supply sources) **14** holding two different types of sequins, suiting such a combined sequin-sewing design, are set in a manner as shown in FIG. **4**. In the illustrated example of FIG. **4**, the left reel **14** corresponds to the left sequin feed unit **20**, while the right reel **14** corresponds to the right sequin feed unit **21**.

[0041] These two reels **14** are coaxially mounted side by side, or juxtaposed, on a same mounting shaft provided on the fixed base **3**. Further, pairs of first, second and third rollers **15**, **16** and **17** for guiding portions of the continuous sequin strips **13** paid out from the reels **14** are supported on the fixed base **3**, and fourth rollers **18** are supported on the mounting base **4**; each of the pairs of the rollers **15**, **16**, **17** and **18** is also composed of two rollers coaxially mounted side by side. Further, two tension rollers **10** are provided between the first rollers **15** and the second rollers **16**, and these tension rollers **10** are supported on tension bases **72** and **73** rotatably mounted on the shafts of the first and second rollers **15** and **16**, respectively. Torsion springs (not shown) are mounted on the shafts of the first and second rollers **15** and **16**, so that the tension base **72** is normally urged in a clockwise direction of FIG. **2** while the tension base **73** is normally urged in a counterclockwise direction of FIG. **2** and these bases **72** and **73** are normally held in abutting engagement with stoppers **74** secured to the fixed base **3**.

[0042] Portion of the continuous sequin strip **14** paid out from each of the reels **14** is directed to and supported on the first roller **15**, tension roller **10**, second roller **16**, third roller **17** and fourth roller **18** in the mentioned order as shown in FIG. **2**, and then guided to the sequin feed mechanism **19** provided on the mounting base **4**. Thus, as the mounting base **4** is moved to the evacuated position, the continuous sequin strip **13** is appropriately pulled by the fourth roller **18**, so that the sequin strip **13** can be prevented from greatly slackening during the movement of the mounting base **4** to the evacuated position.

[0043] FIG. **7** is a rear perspective view showing in further enlarged scale parts of the sequin feed units **20** and **21**, sequin selection mechanism (**44-50**, **60-67**, etc.) and feeding drive mechanism (**51-59**, etc.), FIG. **8** is a rear view of the sequin selection mechanism and feeding drive mechanism, and FIG. **9** is a sectional view taken along the I-I line of FIG. **8**. As apparent from these figures, the two sequin feed units **20** and **21** are provided on the mounting base **4** in opposed relation to each other and horizontally slidable relative to the mounting base **4** along sliding rods **47** and **48** provided on the mounting base **4**. Such sliding movement of the sequin feed units **20** and **21** is effected by the sequin selection mechanism (**44-50**, **60-67**, etc.); more specifically, the sequin selection mechanism selects and connects any one of the feed units **20** or **21** to the feeding drive mechanism (**51-59**, etc.), and thus, a sequin is fed out from the selected sequin feed unit **20** or **21** by a driving force of the feeding drive mechanism (**51-59**, etc.) being transmitted to the selected sequin feed unit **20** or **21**.

[0044] Although the two sequin feed units **20** and **21** provided in opposed relation to each other are constructed of same mechanical components (i.e., mechanically constructed in the same manner), the feed units **20** and **21** are arranged and shaped in symmetrical relation to each other. Thus, details of the mechanical components of only one of the sequin feed units **20** will be described representatively with reference to FIG. **9**. The sequin feed unit **20** generally comprises a supporting plate **22**; a support plate **23** provided horizontally at the lower end of the supporting plate **22**; the sequin feed mechanism **19** composed of various components (indicated by **24-35** etc.) mounted on the supporting plate **22**; and the cutter section (including fixed cutter blade **23***b* and movable cutter blade **36**) located in the predetermined cutting position at the distal end of the support plate **23**. Portion of the continuous sequin strip paid out from the corresponding reel **14** is directed onto the support plate **23** and then sent toward the cutting position or cutter section by

means of the sequin feed mechanism **19**. The support plate **23** has a slit **23***a* (see FIG. **10**) having an appropriate dimension in the front-rear or Y direction. The slit **8***a* is provided to allow entry therein of an engaging claw **33***a* of a lock lever **33** of the sequin feed mechanism **19** as will be later described.

[0045] First, details of the sequin feed mechanism **19** will be described. Link arm **25** is fixed to the shaft **24** supported on the supporting plate **22**, and a link pin having a slanted distal end surface is fixed to a free end portion of the link arm **25**. Feed lever **29**, having an engaging portion **29***a* at its distal end, is pivotably supported, via a shaft **30**, on a free end portion of the pivot arm or lever **27**. Torsion spring (not shown) for normally urging the feed lever **29** in the clockwise direction is fitted on the shaft **30**, by which the distal end portion of the feed lever **29** is normally urged toward the support plate **23**. With the feed lever **29** urged in the clockwise direction, the pivot lever **27** is normally urged in a direction where it abuts against a stopper **31**. The stopper **31** is in the form of a threaded rod screwed to a bracket **32** secured to the supporting plate **22**, and the stopper **31** is locked by screwing up of a nut. The pivot lever **27** abuts against the rear end of the stopper **31**. The lock lever **33** is provided over the feed lever **29**. The lock lever **33** has an engaging claw (or engaging projection) **33***a* at its one end and a stopper portion **33***b* at its other end. Intermediate portion of the lock lever **33** is pivotably supported, via a pin **35**, on a support block **34** that is in turn fixed to the supporting plate **22**. The engaging claw **33***a* of the lock lever **33** is inserted through a through-hole **29***b* formed in the feed lever **29**. Torsion spring (not shown) is provided on the pin **35** fixed to the support block **34**, and the lock lever **33** is normally biased, by that torsion spring, in the counterclockwise direction. With the lock lever **33** normally biased in the counterclockwise direction like this, the lock lever **33** in its free state abuts against a stopper portion **34***a* of the support block **34**, and thus, the lock lever **33** is held in a posture or position where the end of the engaging claw **33***a* projects into the slit **23***a* of the support plate **23**. The engaging claw **33***a* of the lock lever **33** held in this posture engages the sewing hole Sa of one of the sequins S of the continuous sequin strip **13** led onto the support plate **23** to thereby immovably lock the continuous sequin strip **13** during sequin sewing (cutting).

[0046] The following lines describe details of the cutter section comprising the fixed cutter blade **23***b* and movable cutter blade **36**. Such movable cutter blade **36** is pivotably supported via a pin **37** on a distal end portion of the support plate **23** and is normally held, via a torsion spring **38**, in a retracted or evacuated posture or position where it is spaced upward from the fixed cutter blade **23***b*. The movable cutter blade **36** is depressed by a needle clamp **40**, provided at the lower end of a needle bar **39**, as the needle bar **39** descends. Such depression by the needle clamp **40** causes the movable cutter blade **36** to pivot downward against the resilient biasing force of the torsion spring **38**, so that the movable cutter blade **36** cuts the continuous sequin strip **13** across a connecting portion Sb (see FIG. **10**) of the leading sequin S in conjunction with the fixed cutter blade **23***b*. As the needle clamp **40** ascends together with the needle bar **39**, the movable cutter blade **36** returns to its evacuated position by the restoring or resilient force of the torsion spring **38**.

[0047] Next, with reference to FIG. **9**, a description will be given about a guide mechanism for guiding a portion of the continuous sequin strip **13**, paid out from the reel **14**, to the sequin feed unit **20** or **21**. Bracket **41** is fixed to the supporting plate **22**, and a guide section **42** for directing the continuous sequin strip **13** onto the support plate **23** is provided on the bracket **41**. The guide section **42** is replaceable with another one depending on the width of the continuous sequin strip **13** to be set on the sequin feeder apparatus. Holding member **43**, which is in the form of a resilient plate such as a spring steel plate, is fixed to the bracket **41**. The holding member **43** has its free end portion resiliently abutted against the upper surface of the support plate **23**, and the portion of the continuous sequin strip **13**, delivered via the guide section **42** onto the support plate **23**, is passed between the support plate **23** and the holding member **43**.

[0048] The following lines describe the sequin selection mechanism (**44-50**, **60-67** and the like). As illustrated in FIG. **7**, the sequin feed units **20** and **21** constructed in the aforementioned manner are secured to a slide plate **45** via the respective fixed brackets **44**. Slide members **46** are fixed to left and right end portions of the slide plate **45**. The two slide members **46** are slidably supported on a first rod **47** that is in turn fixed to the mounting base **4**. Second rod **48** is secured at opposite ends to and extends between the two fixed brackets **44**; more specifically, the second rod **48** is slidably supported on support sections **49***a* of a support member **49**. The support member **49** is fixed to a bracket **50** that is in turn fixed to the mounting base **4** via a bearing member **51**.

[0049] FIG. **7** shows a state of the apparatus when one of the sequin feed units **20** (hereinafter referred to as "first sequin feed unit **20**") is selected. FIG. **11** is a front view showing in further enlarged scale the sequin feed units **20** and **21** and sequin selection mechanism in the state of FIG. **7**. FIG. **12** is a front view similar to FIG. **11**, but shows a state of the apparatus when the other sequin feed unit **21** (hereinafter referred to as "second sequin feed unit **21**") is selected. Further, FIG. **13** is a perspective view similar to FIG. **7**, but shows the state of the apparatus when the other or second sequin feed unit **21** is selected.

[0050] As clear from FIG. **11**, a connecting arm **60** is pivotably connected at one end to the slide plate **45** and connected at the other end to one end of a pivot lever **62** that is in turn pivotably supported on a motor base **61** fixed to the mounting base **4**. Drive arm **64** is fixed to the shaft of a motor **63** fixed to the motor base **61**, and the drive arm **64** is connected at its free end to the other end of the pivot lever **62** via a connecting member **65**. Thus, as the motor **63** is reciprocatively driven, the two sequin feed units **20** and **21** together slide in the left-right horizontal (i.e., X) direction. Limiting members **66** for defining limits of a slidable range of the sequin feed units **20** and **21** are provided on the first rod **47** at left and right sides of the left slide member **46**. As shown in FIG. **11**, when the left slide member **46** is in a slide position where it abuts against the right limiting member **66** via a shock-absorbing member **67**, it means that the first sequin feed unit **20** has been selected and positioned in the predetermined sewing operation position. FIG. **8** also shows the state of the apparatus when the first sequin feed unit **20** is selected. In such a state of the apparatus when the first sequin feed unit **20** is selected and positioned in the sewing operation position, not only a link pin **26** of the link arm **25** of the first sequin feed unit **20** engages with an engagement portion **54***a* of a transmission lever **54** of the feeding drive

mechanism (**51**-**59** etc.) but also the sewing hole Sa of a sequin S to be fed out by the first sequin feed unit **20** is positioned in vertical alignment with a needle drop position (i.e., position of a needle-passing hole **71** of) of the needle plate **70**, as shown in FIG. **8**.

[0051] On the other hand, when the left slide member **46** is in a slide position where it abuts against the left limiting member **66** via a shock-absorbing member **67**, it means that the second sequin feed unit **21** has been selected and positioned in the sewing operation position, as shown in FIG. **12**. In this state, not only a link pin **26** of the link arm **25** of the second sequin feed unit **20** engages with the engagement portion **54***a* of the transmission lever **54** of the feeding drive mechanism (**51**-**59** etc.) (see FIG. **13**) but also the sewing hole Sa of a sequin S to be fed out by the second sequin feed unit **21** is positioned in vertical alignment with the needle drop position (i.e., position of the needle passing hole **71** of) of the needle plate **70**. Namely, by causing the two sequin feed units **20** and **21** to slide together, any one of the units **20** and **21** can be selectively positioned in the predetermined sewing operation position. Then, sequin sewing is performed using the selected sequin feed unit **20** or **21**, as will be later described. As a modification of the present invention, any one of the two sequin feed units **20** and **21** may be selectively positioned in the predetermined sewing operation position by selectively moving the one sequin feed unit **20** or **21** instead of causing the two sequin feed units **20** and **21** to slide together.

[0052] Note that the sliding movement for selecting the sequin feed unit **20** or **21** in order to change the sequin to be sewn to from one type to another in the middle of a series of sequin pattern sewing operations is performed by the sequin selection mechanism (**44**-**50**, **60**-**67** and the like) while the needle bar **39** is in a raised or upper position. In this way, it is possible to eliminate a need for temporarily stopping the vertical movement of the needle bar **39** (i.e., effecting so-called "jumping" of the needle bar **39**) in order to switch between the sequin types, so that the sewing efficiency can be enhanced.

[0053] The following lines describe the feeding drive mechanism (**51**-**59** etc.). Referring to FIG. **7** or **9**, a pivot shaft **52** is pivotably supported on the bearing member **51** mounted on the mounting base **4**, and a driven lever **53** and the transmission lever **54** are fixed to the pivot shaft **52**. The transmission lever **54** has, in its free end, an engagement portion **54***a* in the form of a U-shaped recess that engages with the link pin **26** of the link arm **25** of each of the sequin feed units **20** and **21**. As each of the units **20** and **21** is caused to slide horizontally, the engagement portion **54***a* in the form of a U-shaped recess allows the link pin **26** of each of the sequin feed units **20** and **21** to move horizontally relative to the engagement portion **54***a*, so that only the link arm **26** of the selected one sequin feed unit **20** or **21** engages with the engagement portion **54***a*. Each of the link pins **26** may have a slanted distal end surface to permit smooth engagement with the engagement portion **54***a*. Note that such a slanted surface may be formed on the engagement portion **54***a* of the transmission lever **54** rather than on each of the link pins **26**, or on both the link pins **26** and the engagement portion **54***a*.

[0054] The driven lever **53** has its free end portion connected to a free end portion of a driving lever **56** via a connecting link **55**, and the driving lever **56** is fixed to the shaft of a motor **57** secured to the left side surface of the mounting base **4**. Torsion spring **58** is provided on the pivot shaft **52**, which normally urges the driven lever **53** and transmission lever **54** in the clockwise direction of FIG. **9** so that an abutting piece **56***a* of the driving lever **56** normally abuts against a stopper **59**. To feed out a sequin, the motor **57** performs one reciprocative stroke driving; that is, the motor **57** is caused to pivot through a predetermined angle in the counterclockwise direction of FIG. **9** and then rotated back (returned) through a predetermined angle in the clockwise direction.

[0055] Next, sequin feeding operation by the sequin feed mechanism **19** will be described. First, in response to counterclockwise rotational driving (i.e., forward driving operation) of the motor **57**, the driving lever **56** is caused to pivot through a predetermined angle in the counterclockwise direction so that a connection between the lower end of the connecting link **55** and the free end of the driven lever **53** is caused to pivot downward through a predetermined angle in the counterclockwise direction. Thus, the pivot shaft **52** is caused to pivot through a predetermined angle in the counterclockwise direction, so that the engagement portion **54***a* at the lower end of the transmission lever **54** is driven rearwardly (rightward or counterclockwise in FIG. **9**). As the engagement portion **54***a* is driven rearward, the link pin **26** of the sequin feed mechanism **19** of one of the sequin feed units **20** or **21**, currently engaging with the engagement portion **54***a*, moves rearward together with the engagement portion **54***a*. In the sequin feed mechanism **19** of one of the sequin feed units **20** or **21**, the link arm **25** and pivot lever **27** are caused to pivot about the shaft **24** in the counterclockwise direction of FIG. **9** in response to the movement of the link pin **26**, so that the feed lever **29** supported at the free end (lower end) of the pivot lever **27** is moved forward (leftward in FIG. **9**). After that, in response to clockwise rotational driving (i.e., rearward driving operation) of the motor **57**, each of the relevant components is moved in a direction opposite the aforementioned, so that the feed lever **29** supported at the free end (lower end) of the pivot lever **27** is moved forward (rightward in FIG. **9**, i.e. toward the predetermined cutting position).

[0056] One stroke length of the feed lever **29** in the forward or rearward movement generally corresponds to a one-pitch feed amount of the continuous sequin strip **13**. As detailed in the above-discussed No. 2004-167097 laid-open publication, the sequin feeding operation is carried out upon completion of sewing of the leading sequin S (and cutting of the continuous sequin strip across the connecting portion Sb immediately following the leading sequin S) shown in FIG. **10**. By that time, the engaging portion **29***a* at the distal end of the feed lever **29** has engaged with the sewing hole of the next sequin S**1**, and the engaging claw **33***a* of the lock lever **33** has engaged with the sewing hole of some subsequent (e.g., second sequin) of the next sequin S**1**.

[0057] The sequin feeding operation in the instant embodiment, which is generally the same as disclosed in the above-discussed No. 2004-167097 laid-open publication, will be described briefly below. As the feed lever **29** is moved forward (leftward in FIG. **9** or **10**), the engaging portion **29***a* of the feed lever **29** gets out of the sewing hole of the sequin S**1**; at that time, however, the engaging claw **33***a* of the lock lever **33** still remains engaging with the sewing hole of the subsequent sequin, and thus, the continuous sequin strip **13** can be reliably prevented from being undesirably displaced by impact produced when the engaging portion **29***a* of the feed lever **29** gets out of the sewing

hole of the sequin S1. As the feed lever **29** is moved further forward (further leftward in FIG. **9** or **10**) in this state, the lock lever **33** pivots in the clockwise direction of FIG. **9** against the biasing force of the torsion spring through engagement with the edge of the through-hole **29***b* of the feed lever **29**, so that the engaging claw **33***a* of the lock lever **33** moves upward away from the sequin out of the engagement with the sewing hole of the sequin. Then, at the end of the forward stroke, the engaging portion **29***a* of the feed lever **29** is positioned a little ahead (leftward in FIG. **9** or **10**) of the sewing hole of another sequin immediately following the sequin S1 (namely, the engaging portion **29***a* has not yet engaged with the sewing hole of the immediately-following sequin), and the lock lever **33** is still located over the sequin strip. As a modification, arrangements may be made to cause the engaging portion **29***a* of the feed lever **29** to engage with the sewing hole of the sequin immediately following the sequin S1 at the end of the forward stroke. Note that, during the forward stroke, the continuous sequin strip **13**, having disengaged from the engaging claw **33***a* of the lock lever **33**, is held by the spring resiliency of the holding member **43** and thus will not move with the movement of the feed lever **29**.

[0058] As the feed lever **29** is moved rearward (rightward in FIG. **9** or **10**), the engaging portion **29***a* of the feed lever **29** engages with the sewing hole of the sequin immediately following the sequin S1. By the engagement of the engaging portion **29***a* with the sewing hole of the immediately-following sequin, the feed lever **29** feeds the continuous sequin strip **13** toward the predetermined cutting position (i.e., rightward in FIG. **9** or **10**). The edge of the through-hole **29***b* of the feed lever **29** gets out of the engagement with the lock lever **33** during the rearward movement of the feed lever **29**, so that the lock lever **33** is caused to pivot in the counterclockwise direction by the resiliency of the torsion spring fitted on the pin **35**. Thus, the engaging claw **33***a* of the lock lever **33** resiliently contacts the upper surface of the sequin strip **13** and slides along the strip's upper surface relative thereto. At the end of the rearward stroke, the current leading sequin S1 reaches the predetermined cutting position (i.e., sewing position) in a similar manner to the leading sequin S shown in FIG. **10**. Then, the engaging claw **33***a* of the lock lever **33** engages with the sewing hole of a predetermined sequin of the sequin strip **13** in the manner as note above.

[0059] Next, an adjustment mechanism (**68**, **69**) for variably adjusting the cutting position (position relative to a sewing needle **77**) in each of the sequin feed units **20** and **21**. FIG. **14** is a side view of the supporting plate **22** of one of the sequin feed units **20** or **21** taken from a side opposite the side where the sequin feed mechanism **19** is provided. As shown in FIG. **14**, the supporting plate **22** is secured to a fixed bracket **44** via screws **68** passed through an elongated hole **44***a* formed in the fixed bracket **44**. Adjustment screw (or bolt) **69**, having a distal end portion screwed to a threaded hole formed in the supporting plate **22**, is provided on the fixed bracket **44** in such a manner that it is rotatable about its axis but can not move in an axial direction thereof. By loosening the screw **68** fixing the supporting plate **22** and rotating the adjustment screw **69** clockwise or counterclockwise, the supporting plate **22** is moved linearly forward or rearward relative to the fixed bracket **44** so that its position in the front-rear direction can be adjusted. Once the supporting plate **22** has been adjusted to a desired position in the front-rear direction, the screw **68** is tightened to fix the supporting plate **22** to the fixed bracket **44**.

[0060] However, as the supporting plate **22** is adjusted in position as noted above, the link pin **26** of the link arm **25** is also displaced in the front-rear direction so that positional relationship between the link pin **26** and the engagement portion **54***a* of the transmission lever **54** in the returned position would go wrong. But, if the link arm **25** is placed in a freely movable state by loosening in advance a screw **81** (see FIG. **8**), fixing the link arm **25** to the shaft **24**, at the time of positional adjustment of the plate **22**, the transmission lever **54** in the returned position can be prevented from undesirably pivoting as the supporting plate **22** is moved; after completion of the positional adjustment of the supporting plate **22**, it is only necessary to again fix the link arm **25** to the shaft **24** by tightening the screw **81**.

[0061] Through the positional adjustment of the supporting plate **22**, the sequin feed unit **21** is adjusted in position in the front-rear direction. Because the sewing needle **77** attached to the needle bar **39** of the machine head is relatively fixed in position (horizontal position), the aforementioned front-rear positional adjustment of the sequin feed unit **21** can adjust the position of the cutter section (**36** and **23***b*) relative to the sewing needle **77**, i.e. cutting position (or horizontal distance between the axis of the vertical movement of the sewing needle **77** and the fixed cutter blade **23***b*). The cutting position is adjusted in accordance with the size of each sequin (i.e., distance from the sewing hole Sa to the connecting portion Sb of the sequin as shown in FIG. **10**) of a continuous sequin strip **13** to be set on the sequin feed unit **21**. Thus, such adjustment of the cutting position is performed when the reel (sequin holder) **14** holding a continuous sequin strip **13** of one sequin size (or one sequin feed size) and mounted in correspondence with the sequin feed unit **21** is to be replaced with another reel (sequin holder) **14** holding a continuous sequin strip **13** of another sequin size (or another sequin feed size). More specifically, when a reel **14** holding a continuous sequin strip **13** of one sequin size has been newly set, for example, a portion of the continuous sequin strip **13** is paid out and placed onto the support plate **23**, then the leading sequin S is positioned a little ahead of the fixed cutter blade **23***b* so that the connecting portion Sb of the leading sequin S aligns with the fixed cutter blade **23***b* as illustrated in FIG. **10**, and thence the adjustment screw **69** is rotated clockwise or counterclockwise to thereby adjust the front-rear position of the sequin feed unit **21**.

[0062] The instant embodiment is not limited to the aforementioned "following" adjustment; for example, the cutting position of the sequin feed unit **21** may be adjusted by measuring a distance from the center of the sewing needle **77** to the fixed cutter blade **23***b* on the basis of data indicative of the distance from the sewing hole Sa to the fixed cutter blade **23***b* and adjusting the measured distance to equal the distance indicated by the data. Alternatively, such adjustment based on the measured distance data and copying adjustment may be used in combination. Further, a suitable scale may be provided in relation to the adjustment screw **69** so that correspondency between the current setting of the adjustment screw **69** and the cutting position (or distance from the center of the sewing needle **77** to the fixed cutter blade **23***b*) can be grasped on the basis of the scale. The adjustment mechanism is not limited to one using the adjustment screw **69** as set forth above and may be one using

another linear displacement mechanism. In an alternative, the adjustment screw **69** may be omitted, in which case the supporting plate **22** may be adjusted in its front-rear position by the human operator holding and moving the supporting plate **22** with his or her hand with the supporting-plate adjusting screw **68** loosened in advance. In another alternative, the cutting position may be variably adjusted by automatically linearly displacing the corresponding sequin feed unit **20** or **21** using a drive means, such as a linear motor.

[0063] The mechanism for adjusting the cutting position of the other sequin feed unit **20** is constructed in the same manner as the aforementioned cutting-position adjusting mechanism of the sequin feed unit **21**. However, it should be noted that, in the instant embodiment of the present invention, the cutting position, i.e. position of the cutter section (**36** and **23***b*) relative to the sewing needle **77**, of each of the sequin feed units **20** and **21** can be adjusted independently of the cutting position of the other sequin feed unit. Namely, whereas each of the sequin feed units **20** and **21** is slidable in the left-right horizontal direction integrally with the fixed bracket **44** in response to the movement of the above-mentioned slide plate **45**, the cutting positions of the sequin feed units **20** and **21** can be adjusted independently of each other because the feed units **20** and **21** are independently adjustable in position in the front-rear direction relative to the fixed bracket **44**. Thus, if the respective cutting positions of the sequin fced units **20** and **21** are adjusted in accordance with the sequin sizes (i.e., distances from the sewing hole Sa to the connecting portion Sb) of continuous sequin strips set on the units **20** and **21**, and if the sequin sizes are different from each other, the position, in the front-rear direction, of the support plate **23**, i.e. the position of the cutter section (**36** and **23***b*), will differ between the units **20** and **21**.

[0064] The following lines describe variable setting of the sequin feed amount (feed pitch) of the sequin feed mechanism **19** in each of the sequin feed units **20** and **21**. When a reel **14** holding a continuous sequin strip **13** requiring sequin feed pitch adjustment has been newly set on any one of the sequin feed units **20** and **21**, the sequin feed amount (feed pitch) of the sequin feed mechanism **19** in the unit **20** or **21** is first adjusted in the following manner. First, the screw **28** (see FIG. **9**) fixing the pivot lever **27** is loosened to allow the human operator to readily rotate the pivot lever **27** with a hand relative to the pivot shaft **24**. Further, the nut of the stopper **31** is loosened to cancel the locking by the stopper, and a portion of the continuous sequin strip **13** is paid out from the reel **14** onto the support plate **23** until the leading sequin S is positioned a little ahead of the fixed cutter blade **23***b*, so that the connecting portion Sb aligns with the fixed cutter blade **23***b* as illustrated in FIG. **10**. Such a state corresponds to a "feed-out completed position" where one-pitch sequin feeding has been completed by the sequin feed mechanism **19**. In this "feed-out completed position", the pivot lever **27** and feed lever **29** are manually moved to cause the engaging portion **29***a* of the feed lever **29** to engage with the sewing hole of the second sequin S**1** from the leading end of the strip **13**. Namely, the pivot lever **27** and feed lever **29** are caused to follow the "one-pitch-feed-out completed position". Then, the nut of the stopper **31** is again tightened for locking the stopper **31**, and the screw **28** is tightened to fix the pivot lever **27** relative to the pivot shaft **24**.

[0065] Then, the locked condition of the support block **34** of the lock lever **33** is canceled, and the lock lever **33** is adjusted with the pivot arm or lever **27**, feed lever **29** and continuous sequin strip **13**, lying on the support plate **23**, held in the "feed-out completed position". Then, with the stopper portion **33***b* at the upper end of the lock lever **33** abutted against the stopper portion **34***a* of the support block **34**, the lock lever **33** is adjusted in position by manually adjusting the position, in the front-rear position, of the support block **34** so that the engaging claw **33***a* of the lock lever **33** engages with the sewing hole of a predetermined sequin of the continuous sequin strip **13** lying on the support plate **23**; the predetermined sequin is several sequins after (e.g., second sequins from) the sequin S**1** engaged by the engaging portion **29***a* of the feed lever **29**. The support block **34** is locked with the lock lever **33** adjusted in position in the aforementioned manner.

[0066] In variably setting the sequin feed amount (feed pitch) of the sequin feed mechanism, the "feed-out completed position", i.e. start position (=end position) of the reciprocative stroke for effecting one-pitch sequin feeding, is set/adjusted through mechanical positional adjustment of the pivot lever **27**, feed lever **29** and lock lever **33**. Then, the end position (=start position) of the reciprocative stroke for effecting one-pitch sequin feeding is set/adjusted by setting data indicative of a rotational range of the motor **57**, which effects one-pitch sequin feeding driving, to a value corresponding to a one-pitch feed amount of the feed lever **29**. Such data indicative of a rotational range of the motor **57** may be set by human operator's manual setting operation on an operation panel **90** (FIG. **1**) of the sewing machine, or may be incorporated in advance in embroidery sewing data as sequin-feed-amount setting data. Needless to say, data setting for setting a one-pitch feed amount is performed independently for each of the sequin feed units **20** and **21**. Namely, although the same or common motor **57** is used for sequin feeding driving, when the motor **57** should perform sequin feeding driving for the first sequin feed unit **20**, the driving by the motor **57** is controlled in accordance with a feeding driving amount (rotational range) set for the feed unit **20**, but, when the motor **57** should perform sequin feeding driving for the second sequin feed unit **21**, the driving by the motor **57** is controlled in accordance with a feeding driving amount (rotational range) set for the feed unit **21**.

[0067] Basically, the feeding may be performed using, as one feed pitch, the size (i.e., diameter) of a sequin to be fed out; in practice, however, a value slightly greater than the sequin size (i.e., diameter) is set as a one-pitch feed amount of the feed lever **29**, in order to allow feed-out of the sequin strip **13** to be effected with an increased reliability. For example, in the case of a sequin having a 6 mm diameter, the one-pitch feed amount is set at about 7 mm, or in the case of a sequin having a 4 mm diameter, the one-pitch feed amount is set at about 5 mm. Namely, by setting the one-pitch feed amount of the feed lever **29** to a value slightly greater than the sequin size (i.e., diameter), the engaging portion **29***a* of the feed lever **29** is positioned a little ahead (leftward in FIG. **9** or **10**) of the sewing hole of another sequin immediately following the leading sequin S**1** (namely, the engaging portion **29***a* has not yet engaged with the sewing hole of the immediately-following sequin) at the end of the forward stroke. Once the rearward stroke starts in this state, the engaging portion **29***a* of the feed lever **29**

enters and engages with the sewing hole of the sequin immediately following the leading sequin S1, so that the continuous sequin strip **13** can be fed toward the cutting position. The one-pitch feed amount of the feed lever **29** may be set at the same value as the sequin size (diameter) in principle, in which case, however, the engaging portion **29***a* of the feed lever **29** might stop short of the sewing hole of the sequin immediately following the leading sequin S1, instead of entering the sewing hole of the immediately-following sequin, due to an error at the end of the forward stroke of the feed lever **29**. Thus, even when the feed lever **29** then starts the rearward stroke, the engaging portion **29***a* of the feed lever **29** does not engage with the sewing hole of the sequin, so that the feed lever **29** will not perform feeding of the continuous sequin strip **13**. In order to forestall such an inconvenience, it is preferable to set the one-pitch feed amount of the feed lever **29** to a value slightly greater than the sequin size (i.e., diameter) as noted above.

[0068] The following paragraphs describe an example of the sequin sewing operation using the aforementioned sequin feeder apparatus **1**. In the case where sequin sewing is to be performed using the machine head H having the sequin feeder apparatus **1** set thereon, two different types of sequins can be sewn as desired by using the two sequin feed units **20** and **21** during sewing of an embroidery pattern while switching between the units **20** and **21**. According to the present invention, as set forth above, each of the sequin feed units **20** and **21** is capable of setting/changing its sequin feed pitch as desired, and thus, the "two different types of sequins" may differ in any of not only shape and color but also size (diameter). Further, even the same sequin feeder apparatus **1** can sew sequins of any desired size (diameter), i.e. any desired feed pitch, in accordance with a desired sequin sewing design. Note that sewing control to be described below is implemented by a not-shown control device (e.g., computer) executing a sewing control program, containing a sequence of operations to be explained below, on the basis of desired sequin-design sewing pattern data related to two-sequin-combined embroidery. Although a flow chart of the sewing-controlling operational sequence is not shown here, such a flow chart may be readily realized on the basis of the following description of the sewing-controlling operational sequence.

[0069] First, two reels **14** holding, i.e. having wound thereon, continuous sequin strips **13** differing in sequin shape, color and/or size are prepared in accordance with a two-type-sequin-combined embroidering design and then set on the base **3** side by side in correspondence with the two sequin feed units **20** and **21** Portions of the sequin strips **13** are paid out from the two reels **14**, then directed to and supported on the first rollers **15**, tension rollers **10**, second rollers **16**, third rollers **17** and fourth rollers **18** in the mentioned order and then guided to the feed units **20** and **21**. The portion of the continuous sequin strip **13** paid out from the right reel **14** in FIG. **4** is directed to the support plate **23** of the right feed unit **21**, while the portion of the continuous sequin strip **13** paid out from the left reel **14** in FIG. **4** is directed to the support plate **23** of the left feed unit **20**, The guide sections **42** (FIG. **9**) corresponding to the sequin feed units **20** and **21** are replaced, if necessary, in accordance with the widths of the sequin strips **13**. Then, various adjustment, such as adjustment of the "cutting position" and "feed amount" is also performed in the above-described manner in accordance with the sequin sizes of the set continuous sequin strips **13**; such adjustment may be performed in suitable order.

[0070] After completion of predetermined adjustment and setting, the operation of the sewing machine is started, upon which sequin embroidery sewing is carried out under the control of the control device and on the basis of desired sequin-pattern sewing pattern data using a combination of at least two types of sequins. For example, the desired sequin sewing pattern data are embroidery sewing data of a format programmed to realize a desired sewing pattern and include data for driving the embroidery frame along the X and Y axes in accordance with the desired sewing pattern. The sewing pattern data also include data for selecting sequins to be used for sewing in correspondence with an initial stitch and groups of desired one or a plurality of stitches. First, which one of the sequin feed units **20** and **21** should be used is instructed on the basis of the data for selecting a sequin in correspondence with the initial stitch. If use of the first sequin feed unit **20** has been instructed, the motor **63** is driven to position the first sequin feed unit **20** in the sewing operation position as shown in FIG. **11**. In this state, the motor **57** is driven, per sewing operation, to cause the pivot lever **27** of the first sequin feed unit **20** to pivot and thereby feed the continuous sequin strip **13**. The leading sequin S of the thus-fed continuous sequin strip **13** is sewn onto a fabric, held taut on the embroidery frame **80**, by means of the sewing needle **77**, and the movable cutter blade **36** is driven downward by the needle clamp **40** of the needle bar **39** lowered simultaneously with the sewing needle **77**. The leading sequin S thus sewn is cut off from the sequin strip **13**. In the aforementioned manner, sequins fed by the first sequin feed unit **20** can be sewn to the fabric.

[0071] Once a stitch at which a sequin change or switch from one type to another is to be effected arrives as the sequin sewing progresses, use of the second sequin feed unit **21**, for example, is instructed on the basis of the embroidery sewing data. Then, while the needle bar **39** is in its raised position, the motor **63** is driven to position the second sequin feed unit **21** in the sewing operation position as illustrated in FIG. **12**. Thus, after that, the driving force of the motor **57** is transmitted to the pivot lever **27** of the second sequin feed unit **21**, so that the continuous sequin strip **13** of the second sequin feed unit **21** is fed to the cutting position. In order that the sequin-changing (i.e., sequin-switching) slide and sequin feed-out operations may be performed while the needle bar **39** is in its raised position during one up-down movement cycle, the sequin-changing slide operation is performed first, and then the one-reciprocative-stroke driving for sequin feed-out is performed by the motor **57**. In this manner, sequins fed by the second sequin feed unit **21** can be sewn to the fabric. Then, the sequin feed unit to be used for the sewing can be changed or switched to the other as needed.

[0072] In the aforementioned manner, the first embodiment of the invention can change the sequin to be sewn from one type to another without stopping the rotation of the sewing machine and without jumping the needle bar **39**. Of course, the manner of the sequin change control in the instant embodiment is not limited to the aforementioned, and the needle bar **39** may be jumped throughout the sequin-changing slide operation.

[0073] Note that the present invention is not limited to the case where the embroidery sewing data include sequin-selecting (changing) data only in correspondence with a

stitch at which a sequin change is to be effected as noted above; the embroidery sewing data may include sequin-selecting (changing) data per stitch.

[0074] In an alternative, the sequin-changing slide control may be automatically performed on the basis of a predetermined sequin changing pattern or may be manually performed as necessary in response to operation, by the human operator, of the operation panel **90**, instead of being performed on the basis of embroidery sewing data as set forth above. For example, the "predetermined sequin changing pattern" may be one in accordance with which a predetermined number n of sequins of the first sequin feed unit **20** are sewn in succession and then a predetermined number m of sequins of the second sequin feed unit **21** are sewn in succession; thus, the sequin to be sewn can be changed from one type to another through repletion of the pattern. In such a case, it is preferable that the "n" and "m" values may be manually set/changed as desired by the human operator operating the operation panel **90**. In still another alternative, a plurality of different sequin changing patterns may be prepared in advance so that the human operator can select, as necessary, any desired one of the sequin changing patterns by operating the operation panel **90**.

[0075] In the above-described embodiment, the two sequin feed units **20** and **21** symmetrically arranged and substantially identically constructed are provided in opposed relation to each other. Alternatively, such identically-constructed sequin feed units **20** and **21** may be provided side by side in a same orientation. In such a case, the shape of the link arm **25**, fixing the link pin **26**, is modified so that the link arm **25** can move without interfering with the transmission lever **54** during the sliding movement of the feed units **20** and **21**. In the case where the link arm **25** is modified in shape and construction as noted above, three or more sequin feed units, rather than the two sequin feed units **20** and **21**, can be provided side by side in such a manner that any desired one of the feed units can be selected through the sliding movement. Thus, switching can be made among three or more types of sequins

[0076] The first embodiment has been described above as constructed to adjust the cutting position of each of the sequin feed units **20** and **21** through positional adjustment of the supporting plate **22** (i.e., the whole of the sequin feed unit in question). Alternatively, the support plate **23** may be made adjustable in position relative to the supporting plate **22** so that desired adjustment of the cutting position can be performed through positional adjustment of the support plate **23** alone. In such a case, the mechanism for linearly displacing the support plate **23** may employ a rotation-to-linear-displacement conversion mechanism, such as the above-mentioned adjustment screw **69**, linear motor, or the like.

Second Embodiment

[0077] With reference to FIGS. **16-20**, the following paragraphs describe a sequin feeder apparatus **100** in accordance with a second embodiment of the present invention.

[0078] FIG. **16** is a right side view of the sequin feeder apparatus **100**, which is provided with a detection device **101** for detecting that the entirety of a continuous sequin strip **13** has been supplied from the reel **14**. Namely, the detection device **101** is provided for detecting whether the supply from any of the supply sources (reels) **14** to the respective sequin feed units **20** and **21** has stopped. The sequin feeder apparatus **100** according to the second embodiment is slightly different, in installed position of the rollers for guiding the sequins strips **13** paid out from the reels **14**, from the sequin feeder apparatus **1** because of the provision of the detection device **101**, but, the two embodiments are identical to each other in the other structural features.

[0079] FIGS. **17-20** are views showing in enlarged scale an example construction of the detection device **101**. More specifically, FIG. **17** is a side view of the detection device **101**, FIG. **18** is a view taken in a direction of arrow A of FIG. **17**, and FIG. **19** is a sectional view taken along the B-B line of FIG. **17**. Mounting bracket **102** of the detection device **101** includes a mounting section **102***a* mounted on the fixed base **3**, and a first base plate **102***b* bent at a right angle from the mounting section **102***a*. As shown in FIG. **18**, the first base plate **102***b* has a projection **103** of an inverted T shape formed integrally with the lower edge thereof, and guiding portions **103***a* and **103***b* for guiding the respective continuous sequin strips **13** extend leftward and rightward from the projection **103**. Second base plate **104**, having a similar shape to the first base plate **102***b*, is secured, by means of a stud **105**, to the mounting bracket **102** in parallel with the first base plate **102***b*. Namely, the second base plate **104** has guiding portions **104***a* and **104***b* similar to the guiding portions **103***a* and **103***b* of the first base plate **102***b*. Thus, as shown in FIG. **19**, the two continuous sequin strips **13**, hanging down from above, are guided by the left and right guiding portions **103***a*, **103***b* and **104***a*, **104***b* with each of the continuous sequin strips **13** supported at two points by a pair of the preceding and succeeding guiding portions **103***a* and **104***a* (**103***b* and **104***b*). Between the first and second base plates **102***b* and **104**, right and left levers **106** and **107** are rotatably mounted via a pin provided on the projection **103**. The right and left levers **106** and **107** has respective arms **106***a* and **107***a* capable of abutting against the corresponding continuous sequin strips **13** supported by the preceding and succeeding (i.e., upper and lower) guiding portions **103***a*, **104***a* and **103***b*, **104***b*, and detecting portions (made of metal) **106***b* and **107***b* extending from the right and left levers **106** and **107**, respectively. Knobs **108** are provided at the respective ends of the levers **106** and **107**.

[0080] Each of the right and left levers **106** and **107** functions as a displacement member displaceable between first and second positions. The "first position" is where the displacement member (lever **106** or **107**) is held in abutting contact with the corresponding continuous sequin strip **13**, while the "second position" is where the displacement member (lever **106** or **107**) is located past the first position, without abutting against the corresponding continuous sequin strip **13**, due to a stoppage (i.e., runout) of the supply of the continuous sequin strip **13**.

[0081] FIG. **18** shows where the two continuous sequin strips **13** supported by pairs of the preceding and succeeding guiding portions **103***a*, **104***a* and **103***b*, **104***b*. In this state, the arms **106***a* and **107***a* of the right and left levers **106** and **107**, having pivoted downward by the weights of the respective knobs **108**, are in abutting contact with the corresponding continuous sequin strips **13** from above; hardly, the right and left levers **106** and **107** are each held in the first position. On the other hand, when the continuous sequin strip **13** is not being supported by the guiding portions **103***a*, **103***b* (**104***a*, **104***b*), i.e., when the supply of the continuous sequin strip **13** has run out as shown in FIG. **20**, the right lever **106** pivots

in the clockwise direction by the weight of the knob **108** to pass between the guiding portions **103***a* and **104***a*, so that the lever **106** takes a posture where the corresponding knob **108** is oriented vertically; namely, the lever **106** takes the second position.

[0082] Magnetic sensor **109** is provided on the upper surface of the second base plate **104** and on pivoting trajectories of the detecting portions **106***b* and **107***b*, and a permanent magnet **110** is provided on the lower surface of the first base plate **102***b*. When none of the detecting portions **106***b* and **107***b* is located between the magnetic sensor **109** and the permanent sensor **110** as shown in FIG. **18**, the magnetic sensor **109** is kept in an ON state. But, as the right lever **106** pivots, from the position of FIG. **18**, in the clockwise direction (i.e., shifts from the first position to the second position) due to a stoppage (runout) of the supply of the right (-side) continuous sequin strip **13** as shown in FIG. **20**, the detecting portion **106***b* passes transversely between the magnetic sensor **109** and the permanent sensor **110** and thereby temporarily blocks out the magnetism of the permanent magnet, so that the magnetic sensor **109** is shifted to an OFF state. In this way, it is possible to detect that the supply of the continuous sequin strip **13**, so far has been paid out or supplied from the reel **14**, has run out.

[0083] The detection device **101** in the second embodiment operates as follows at the time of sequin sewing. First, as in the first embodiment, two reels **14** holding, or having wound thereon, continuous sequin strips **13** differing in shape and/or size, are set side by side on the fixed base **4**. Portions of the continuous sequin strips **13**, paid out from the reels **14**, are passed to and engaged with the individual rollers and detection device **101** and then directed to the corresponding sequin feed units **20** and **21**. In the detection device **101**, the continuous sequin strips **13** are set on the guiding portions **103***a*, **104***a* and **103***b*, **104***b*, respectively. When a continuous sequin strip **13** is set relative to the right side of the detection device **101**, for example, the following operation takes place. As long as no continuous sequin strip **13** is set on the right side of the detection device **101**, the right lever **106** is held in the second position where the knob **108** is oriented vertically downward as shown in FIG. **20**. Thus, the human operator holds the knob **108** of the right lever **106** to cause the right lever **106** to pivot from the second position in the counterclockwise direction until the arm **106***a* of the right lever **106** is located above the first position shown in FIG. **18**, after which the operator inserts and sets the right-side continuous sequin strip **13** between the arm **106***a* and the guiding portions **103***a*, **104***a*. In this manner, the right lever **106** is held in the first position where the arm **106***a* is held horizontally with the right lever **106** supported by the upper surface of the continuous sequin strip **13** that is in turn supported at two points thereof by the preceding and succeeding guiding portions **103***a* and **104***a*. Left-side continuous sequin strip **13** can be set relative to the left side of the detection device **101** in generally the same manner as the right-side continuous sequin strip **13**.

[0084] When sequin sewing is started after the continuous sequin strips **13** have been properly set in place in the aforementioned manner, the two levers **106** and **107** are held in the first position as shown in FIG. **18** and the magnetic sensor **109** is kept in the ON state detecting the magnetism of the permanent magnet **110**, as long as there exist the sequin strips **13** on the detection device **101**. Then, once the supply of one of the continuous sequin strips (e.g., right-side continuous sequin strip) **13** runs out and the right-side continuous sequin strip **13** is no longer present at the guiding portions **103***a* and **104***a*, the right lever **106** pivots downward to the second position shown in FIG. **20**. At that time, the detecting portion **106***b* of the right lever **106** passes transversely between the magnetic sensor **109** and the permanent magnet **109**, so that the magnetism of the permanent magnet **21** is temporarily blocked out and thus the magnetic sensor **109** is temporarily placed in the OFF state and then returns to the ON state. Output of the magnetic sensor **109** is supplied to a not-shown control device. When the control device detects that the output of the magnetic sensor **109** has switched to the OFF state, it determines that the supply of the continuous sequin strip **13** has run out, so that it automatically deactivates the sewing machine and informs, via suitable visible and/or audible means, the human operator that the supply of the continuous sequin strip **13** has run out.

[0085] In the aforementioned detection device **101**, the magnetic sensor **109** is kept in the ON state while the lever **106** or **107** is held in the second position. Thus, when sequin sewing is to be performed with a continuous sequin strip **13** set only on one of the two sequin feed units (i.e., with no sequin color change to be effect), there is no need to make an arrangement for preventing a state of the other sequin feed unit, where no continuous sequin strip **13** is set, from being detected, e.g. by evacuating the lever **106** or **107** of the other sequin feed unit. Because the lever **106** or **107** of the other sequin feed unit, where no continuous sequin strip **13** is set, is held in such a manner that the corresponding knob **108** is oriented vertically downward by its own weight alone, the lever **106** or **107** of the other sequin feed unit might undesirably pivot if the embroidery sewing machine vibrates greatly, which tends to result in a false detection. To avoid such an inconvenience, holding members, such as leaf springs, may be provided to restrict movement the levers **106** and **107** such that, when any one of the levers **106** or **107** is in the second position (where the knob **108** is oriented vertically downward), the lever **106** or **107** can be reliably prevented from undesirably pivoting due to vibration. Alternatively biasing members, such as torsion springs, for normally urging the levers **106** and **107** to the second position (i.e., position where the knob **108** is oriented vertically downward), in which case it is preferable to provide stoppers for holding the thus-urged levers **106** and **107** in the second position.

[0086] Note that, in the above-described second embodiment, the detection device **101** only detects that any one of the two continuous sequin strips **13** has run out and does not specifically detect which one of the two continuous sequin strips **13** has run out. This is because the second embodiment can achieve necessary and sufficient functions by automatic deactivation of the sewing machine or information to the human operator based on the mere detection that any one of the two continuous sequin strips **13** has run out. However, the present invention is not so limited, and two detection devices of the aforementioned construction may be provided, in correspondence with two continuous sequin strips **13** to be set, so as to specifically detect which one of the two continuous sequin strips **13** has run out.

[0087] Note that the detection device **101** for detecting that a continuous sequin strip **13** has run out is also applicable to sequin feeder apparatus of the conventionally-known type where only one continuous sequin strip is set

and fed, instead of being limited to the sequin feeder apparatus **1** of the type where two or more continuous sequin strips **13** are set side by side to permit sequin selection or change as desired. In such a case, the construction of the detection device **101** shown in FIGS. **17-20** may be used as-is, and the continuous sequin strip **13** only has to be guided by the left- or right-side guiding portions **103***a* and **104***a* (or **103***b* and **104***b*). Alternatively, the construction of the detection device **101** shown in FIGS. **17-20** may be modified; for example, there may be provided only the left- or right-side **103***a* and **104***a* (or **103***b* and **104***b*) and the corresponding lever **106** (or **107**).

[0088] Further, the detection device **101** may comprise any suitable detection means, such as an optical sensor or mechanical sensor, rather than a magnetic sensor.

Other Improvements or Modifications

[0089] According to the present invention, spring members for holding the two reels **14** sideways against excessive rotation are provided at positions where the reels **14** are set side by side. Thus, some force would act on the two juxtaposed reels **14** such that the reels **14** tend to rotate together; consequently, as one of the reels **14**, which is currently involved in sequin sewing, rotates, the other reel **14**, which is not currently involved in the sequin sewing, may undesirably rotate together with the one reel **14** and slacken to have adverse influences on the sequin sewing. To avoid such adverse influences, it is desirable to take some measure to prevent the two reels **14** from rotating together. As an example of such a measure, a key groove may be formed in the mounting shaft supporting the reels **14**, and a washer having a key formed, on its inner periphery, for fitting engagement with the key groove may be provided between the two reels **14**. Alternatively, a part of the mounting shaft may be formed into a substantial D sectional shape, and a washer having a hole corresponding in sectional shape to that part may be provided between the two reels **14**. In this way, the two reels **14** can be reliably prevented from rotating together, and, besides, the holding force applied sideways effectively acts on both of the reels **14**.

[0090] Further, the mounting base **4** may be constructed so that it can also be stopped and held in an intermediate position between the lowered position and the evacuated position. For example, when the sequin sewing operation is to be switched to the embroidery operation by the sequin needle bar, it has been conventional to hold the mounting base in the lowered position in order to reduce the necessary working time; however, according to the modification of the present invention, the mounting base **4** is raised from the lowered position to the intermediate position without the sewing machine being deactivated. With such a modification, it is possible to avoid the inconveniences that the movable cutter blade **36** is easily damaged by being unnecessarily hit by the needle clamp **40**. Furthermore, the modification can reduce the time required for ascending and descending of the mounting base **4**, and, because the sewing machine is not deactivated, it can effectively reduce the loss of the operating time as compared to the case where the switching from the sequin sewing operation to the embroidery operation is effected with by the base **4** held in the lower position. Alternatively, the needle bar may be held in the jumping state, in which case too the loss of the operating time can be considerably reduced. Note that the "intermediate position" of the mounting base **4** may be any suitable position where the movable cutter blade **36** is not hit by the needle bar **40**. Also note that, in the case where the mounting base **4** is constructed to be able to be stopped and held in the intermediate position as noted above, the mounting base **4** may be evacuated from the intermediate position to the evacuated position upon deactivation of the sewing machine. Further, the human operator may set individually whether the mounting base **4** should be held in the lowered position or should be raised to the intermediate position or to evacuated position in various predetermined states, such as when the thread is to be cut and when a thread breakage has been detected.

[0091] In the case where the sequin feeder apparatus **1** is attached to the left side of the needle bar case **2** as shown in FIG. **1**, a state or position where the right-side sequin feed unit **21** of the two sequin feed units **20** and **21** is in the sewing operation position may be set as a "reference position"; namely, when the sequin sewing operation is not to be performed, the right-side sequin feed unit **21** may be positioned in the sewing operation position. Thus, in an operation for threading a needle bar located immediately to the right of the sequin needle bar, for example, the threading can be performed with ease without being interfered with by the sequin feeder apparatus **1**. In the case where the sequin feeder apparatus **1** is attached to the right side of the needle bar case **2**, on the other hand, a state or position where the left-side sequin feed unit **20** is in the sewing operation position may be set as the "reference position".

[0092] Furthermore, for each of the sequin feeder apparatus **1**, there may be provided a feeding switch operable to instruct an operation for feeding a continuous sequin strip **13**, a switching switch operable to instruct that the sequin feed unit to be used for feeding the continuous sequin strip **13** be changed or switched over to the left or right sequin feed unit **20** or **21**, an ascending/descending switch operable to instruct that the sequin feeder apparatus **1** be caused to ascend or descend, and other switches, so that any desired operation can be instructed by the human operator manually operating a corresponding one of the switches.

[0093] During operation of the sewing machine, embroidery sewing data corresponding to several stitches may be pre-read so that sequin changing (switching) can be effected at a stitch preceding the sewing of the several stitches. More specifically, once a particular stitch at which a sequin change is to be effected is identified through pre-reading of the embroidery sewing data, a determination is made as to whether or not the sequin change is possible at a stitch preceding the particular stitch. If the preceding stitch is a stitch at which a sequin is not to be fed out, then it is determined that the sequin change is possible at the preceding stitch. If, on the other hand, the preceding stitch is a stitch at which a sequin is to be fed out, then it is determined that the sequin change is impossible at the preceding stitch, and jump stitch data is inserted for jumping the needle bar between needle stitches so that a sequin change can be effected during the jumping of the needle bar.

[0094] Such a sequin change will be described in more detail below in relation to a case where sequin patterns shown in FIGS. **21** and **22** are to be sewn. The sequin patterns shown in FIGS. **21** and **22** each comprise a pattern to be made by alternately sewing sequins of different sizes, and let it be assumed here that, of the sequin patterns, the large-size sequins A are sewn via the sequin feed unit **21** while the small-size sequins B are sewn via the other sequin

feed unit **20**. In each of FIGS. **21** and **22**, P**1** represents a first "sewing stitch" formed by a first "needle stitch", P**2** a second sewing stitch formed by a second needle stitch, P**3** a third sewing stitch formed by a third needle stitch, P**4** a fourth sewing stitch by a fourth needle stitch, and so on. In the sequin pattern shown in FIG. **21**, there are provided, between the large-size sequins A and the small-size sequins B, "no sequin" stitches where no sequin is sewn, while, in the sequin pattern shown in FIG. **22**, the different-size sequins A and B are sewn successively stitch by stitch, i.e. with no "no-sequin stitch".

[0095] The following lines describe a sequence of operations performed by the control device (e.g., computer) for sewing the sequin pattern shown in FIG. **21**. First, the sequin feed unit **21** is positioned in the sewing operation position in correspondence with the first large-size sequin A to be first sewn to a workpiece, and then the first sewing stitch P**1** corresponding to the first needle stitch is formed with no sequin sewn. Then, the sequin A is fed out via the sequin feed unit **21** and sewn to the workpiece by the second sewing stitch P**2**. Then, sewing of the first small-size sequin B at the fourth needle stitch is identified by pre-reading of embroidery sewing data, and a determination is made as to whether or not a sequin change is possible at the third needle stitch preceding the fourth needle stitch. Because the third needle stitch is where no sequin is to be fed out, it is determined that the sequin change is possible at the third needle stitch. Thus, the control device decides to effect the sequin change at the third needle stitch, on the basis of which the sequin feed unit **20** is positioned in the sewing operation position in correspondence with the small-size sequin B to be next sewn. Then, the third sewing stitch is formed with no sequin sewn, at which time the sequin feed unit to be positioned in the sewing operation position is switched while the needle bar is raised between the second and third needle stitches. Then, the small-size sequin B is fed out via the sequin feed unit **20**, currently positioned in the sewing operation position, and sewn to the workpiece by the fourth sewing stitch P**4**. Then, in a similar manner to the aforementioned, the sequin feed unit **21** corresponding to the second large-size sequin A is positioned in the sewing operation position, and thence the fifth sewing stitch P**5** is formed with no sequin sewn. After that, the aforementioned operations are repeated, so that the sequin pattern shown in FIG. **21** is sewn to the workpiece.

[0096] The following lines describe a sequence of operations performed by the control device (e.g., computer) for sewing the sequin pattern shown in FIG. **22**. First, the sequin feed unit **21** is positioned in the sewing operation position in correspondence with the first large-size sequin A to be first sewn to a workpiece, and then the first sewing stitch P**1** corresponding to the first needle stitch is formed. Then, the sequin A is fed out via the sequin feed unit **21** and sewn to the workpiece by the second sewing stitch P**2**. Then, sewing of the first small-size sequin B at the third needle stitch is identified by pre-reading of embroidery sewing data, and a determination is made as to whether or not a sequin change is possible at the second needle stitch preceding the third needle stitch. Because the second needle stitch is where the large-size sequin A is to be sewn, it is determined that the sequin change is impossible at the second needle stitch, jump stitch data is inserted for jumping the needle bar between the second and third needle stitches. Thus, the needle bar is jumped with a jump stitch, and the sequin feed unit **20** is positioned in the sewing operation position in correspondence with the small-size sequin B to be next sewn. Then, the small-size sequin B is fed out via the sequin feed unit **20** and sewn to the workpiece by the third sewing stitch P**3** corresponding to the third needle stitch. Then, in a similar manner to the aforementioned, jump stitch data is inserted, the needle bar is jumped, and the sequin feed unit **21** is positioned in the sewing operation position in correspondence with the first large-size sequin A. Then, the sequin A is fed out via the sequin feed unit **21** and sewn to the workpiece by the fourth sewing stitch P**4** corresponding to the fourth needle stitch. After that, the aforementioned operations are repeated, so that the sequin pattern shown in FIG. **22** is sewn to the workpiece. Namely, a change or switch from a sequin of one type to a sequin of the other type and feeding of the sequin of the other type may be performed at different stitches, by effecting the sequin change at a stitch preceding the stitch at which the sequin is to be sewn.

[0097] Note that, even where a stitch at which no sequin is to be fed is present before a stitch at which a sequin is to be sewn as in the sequin pattern of FIG. **21**, it may be determined that no sequin change is possible if the embroidery frame **80** is to be moved rearward. This is because, if the embroidery frame **80** is moved rearward, a previously-sewn stitch position will get into under the sequin feed units **20** and **21**, and thus, an upper thread (or needle thread) T may contact the distal or lower end (movable cutter blade **36**) of the sequin feed unit **20** or **21** as shown in FIG. **23**. Thus, if the sequin feed units **20** and **21** differ in position in the front-rear direction, for example, depending on the sizes of the sequins set thereon as illustrated in FIG. **15**, and if switching is made from the sequin feed unit **21** to the sequin feed unit **20**, the upper thread T may enter the cutter section (**36**, **23***b*) of the sequin feed unit **20**. If the upper thread T has entered the cutter section (**36**, **23***b*), not only the sewing is adversely influenced, but also the upper thread T is undesirably cut by the cutter section (**36**, **23***b*) during sewing of a sequin. Thus, in the case where a sequin change at a point when the embroidery frame **80** is to be moved rearward has been determined to be impossible, a further determination may be made as to whether a sequin change is possible at a further preceding stitch that precedes the aforementioned preceding stitch. If the further preceding stitch is a stitch at which no sequin is to be fed out, and if the embroidery frame **80** is to be moved rearward, the desired sequin change is effected at the further preceding stitch. If, on the other hand, no sequin change is impossible at the further preceding stitch too, thenjump stitch data is inserted. Note that, in order to prevent the upper thread T from entering the cutter section (**36**, **23***b*) with an increased reliability, the sequin feed units **20** and **21** may each be provided with a guide member for guiding the upper thread T so as not to enter the cutter section (**36**, **23***b*). Furthermore, by pre-reading the embroidery sewing data, the sewing speed of the sewing machine may start to be lowered several stitches before a stitch at which a sequin change is to be effected; the sewing speed may be returned to a normal speed when no sequin change is to be effected between given stitches.

[0098] The following lines describe an example manner in which a sequin pattern is created using the basic principles of the present invention. Sequin pattern, comprising a heretofore-unachievable, novel pattern structure, can be created by using the sequin feeder apparatus **1** of the present invention to sew two sequins C and D of different types to a workpiece in an overlapped relation to each other as shown

in FIG. **24**. Now, with reference to FIG. **25**, a description will be given about an example sequence of operations performed by the control device (e.g., computer) for creating such a novel sequin pattern. First, one of the sequin feed units **20** or **21** to be used for sewing of the sequin C to a workpiece is positioned in the sewing operation position, and then a first sewing stitch P**1** corresponding to a first needle stitch shown in (a) of FIG. **25** is formed. Next, the sequin C is fed out and sewn to the workpiece by a second sewing stitch P**2** corresponding to a second needle stitch. After that, the other sequin feed units **21** or **20** to be used for sewing of the sequin D to the workpiece is positioned in the sewing operation position, and then a third sewing stitch P**3** corresponding to a third needle stitch is formed. Then, the sequin C is fed out and sewn to the workpiece by a fourth sewing stitch P**4** corresponding to a fourth needle stitch. After that, sewing stitches P**5**, P**6** and P**7** corresponding to fifth, sixth and seventh needle stitches are sequentially formed as shown in (c) of FIG. **25**. In the meantime, the sequin feed unit **20** or **21** to be used for sewing of the next sequin C to the workpiece is positioned in the sewing operation position, and the next sequin C is sewn to the workpiece by an eighth sewing stitch corresponding to an eighth needle stitch. Afterward, the aforementioned operations at the third to eighth needle stitches are repeated, so that the sequin pattern shown in FIG. **24** is sewn to the workpiece. In the aforementioned sewing, some places where two or more sewing stitches overlap occur on the workpiece; in each of these places, the sewing stitches may be formed either at the same position or at positions slightly displaced from each other.

Other Embodiment of Sequin Feeder Apparatus of the Invention

[0099] FIG. **26** is an exploded rear perspective view of a sequin feeder apparatus **120** in accordance with another embodiment of the present invention. FIG. **26** shows in enlarged scale parts of a feeding drive mechanism **121**, sequin selection mechanism **122**, left-side sequin feed unit **123** and right-side sequin feed unit **124**. In this sequin feeder apparatus **120**, each of the sequin feed units **123** and **124** includes an adjustment mechanism for variably adjusting a cutting position (position relative to a sewing needle **77**) in the feed unit **123** or **124**. As detailed later, the sequin feeder apparatus **120** is constructed in such a manner that, in each of the sequin feed units **123** and **124**, the cutting position, adjusted in each of the sequin feed units **123** and **124** in accordance with a sequin size of a continuous sequin strip set on the unit, can be maintained even after detachment of the feed unit from the apparatus **120**, and that the sequin feed units **123** and **124** can be accurately attached to the feeder apparatus **120** by being fixedly positioned at respective predetermined positions.

[0100] The following lines describe constructions of the sequin feed units **123** and **124** and mounting sections thereof. For mounting of the sequin feed units **123** and **124**, the sequin selection mechanism **122** includes base members **125** on its left and right sides. Each of the sequin feed units **123** and **124** includes a mounting bracket **126** having a mounting groove **126***a* and hole **126***b*. Each of the sequin feed units **123** and **124** can be detachably fixed to the corresponding bracket **125** by means of two stepped screws **132**, and the height of the groove **126***a* and diameter of the hole **126***b* of the mounting bracket **126** are appropriately chosen such that shaft portions **132***a* of the stepped screws **132** can be fitted in the groove **126***a* and hole **126***b* with no wobbling or backlash. In this way, the mounting brackets **126** can always be positioned in same positions relative to the corresponding base members **125**.

[0101] Each of the mounting brackets **126** is fixed to a corresponding supporting plate **127** by means of two fastening screws **128**. The mounting bracket **126** includes a mounting section for each of the fastening screws **128**, which has a stepped shape having a through-hole for passage therethrough a threaded portion of the fastening screw **128** and an increased-diameter portion for fitting engagement therein of a head portion of the fastening screw **128**. The through-hole and increased-diameter portion of the mounting section together constitute an elongated hole extending in the front-rear direction of the sequin feeder apparatus. Further, each of the mounting brackets **126** has a guide hole **126**c extending in the front-rear direction of the sequin feeder apparatus so that one of guide pins **129** fixed to the supporting plate **127** can be slidably fitted therein. In each of the mounting brackets **126**, an adjustment screw **130** is supported by a support section **126**d, bent at a right angle from the body of the bracket **126**, in such a manner that the screw **130** is rotatable about its axis but immovable in the axial direction thereof, and the adjustment screw **130** has a distal end portion screwed into a threaded hole of a support member **131** that is in turn fixed to the supporting plate **127**. Thus, in response to rotation of the adjustment screw **130**, the support member **131** having the threaded hole and the supporting plate **127** are linearly displaced without the adjustment screw **130** being linearly displaced. Thus, as the adjustment screw **126** is rotated clockwise or counterclockwise, the supporting plate **127** is linearly displaced in the forward or rearward direction so that its position in the front-rear direction can be adjusted. The other structural elements of the sequin feeder apparatus **120** than the above-described will not be described here because they are similar in function to those of the sequin feeder apparatus **1** according to the first embodiment of the invention although slightly different from the latter in terms of shapes and positions of some of the component parts.

[0102] When some adjustment has to be made for at least one of the sequin feed unit **123** and **124** in the sequin feeder apparatus **120** in accordance with the size of sequins to be sewn, the sequin feed unit **123** or **124**, requiring the adjustment, is detached from the body of the sequin feeder apparatus **120**, and the sequin feed amount (i.e., positional adjustment of the pivot lever and lock lever) of the detached sequin feed unit **123** or **124** is adjusted. After that, the sequin feed unit **123** or **124** is re-attached to the body of the sequin feeder apparatus **120**, and then the cutting position (position relative to a sewing needle **77**) is adjusted by rotating the adjustment screw **130** clockwise or counterclockwise to move the supporting plate **127** in the front-rear direction. Then, the rotational range of the sequin-feeding drive motor is set, as necessary, to a value corresponding to a one-pitch sequin feed amount. Namely, the desired adjustment can be made with ease by detaching the sequin feed unit **123** or **124**, requiring the adjustment, from the body of the sequin feeder apparatus **120** as noted above.

[0103] Further, because each of the mounting brackets **126** can always be positioned in the same position relative to the corresponding base members **125**, the cutting position in the sequin feed unit **123** or **124** will not vary even though the

feed unit **123** or **124** is detached and attached after the supporting plate **127** is positioned in position according to the sequin size. Therefore, if some scale means indicative of adjusted positions of the supporting plate **127** corresponding to various sequin sizes is provided, and if arrangements are made for permitting the cutting position adjustment while the feed unit **123** or **124** is detached from the body of the sequin feeder apparatus **120**, the desired adjustment can be made with ease. Further, such arrangements permit novel usage of the sequin feeder apparatus, in accordance with which sequin feed units adjusted according to various sequin sizes are prepared in advance and switching is made to one of such prepared sequin feed units, which corresponds to the size of a sequin to be used, without making various adjustments in accordance with the size of the sequin to be used.

[0104] Note that, whereas the structure for sliding the sequin selection mechanism in each of the above-described embodiments has been described above as comprising the two rods and member slidably supported on the rods, the present invention is not limited to such a structure and any other desired sliding structure comprising a linear rail may be employed.

[0105] This application is based on, and claims priority to, JP PA 2006-280396 filed on 13 Oct. 2006. The disclosure of the priority application, in its entirety, including the drawings, claims, and the specification thereof, is incorporated herein by reference.

What is claimed is:

1. A sequin feeder apparatus comprising:

at least two sequin feed units each including a sequin feed mechanism for feeding a continuous sequin strip toward a predetermined cutting position and a sequin-cutting cutter section located in the predetermined cutting position;

a sequin selection mechanism for selecting one of said at least two sequin feed units and positioning the selected one sequin feed unit in a predetermined sewing operation position; and

a drive mechanism for engaging with said sequin feed mechanism of said one sequin feed unit, positioned in the predetermined sewing operation position, and thereby driving, in response to a sewing operation, the engaged sequin feed mechanism to feed the continuous sequin strip toward the predetermined cutting position,

wherein the predetermined cutting position in each of said sequin feed units is adjustable independently of the predetermined cutting position in other of said sequin feed units, and

said cutter section is driven, in response to the sewing operation, to cut a sequin off from the continuous sequin strip having been fed to the predetermined cutting position.

2. A sequin feeder apparatus as claimed in claim **1** wherein each of said sequin feed units includes an adjustment mechanism for adjusting a position, relative to a position of a sewing needle, of said cutter section of the sequin feed unit independently of the other of said sequin feed units.

3. A sequin feeder apparatus as claimed in claim **2** wherein said adjustment mechanism of each of said sequin feed units adjusts the cutting position, where said cutter section cuts the sequin off from the sequin strip, by linearly displacing a whole of the sequin feed unit.

4. A sequin feeder apparatus as claimed in claim **2** wherein each of said sequin feed units includes a support plate for supporting thereon the continuous sequin strip to be fed toward the cutting position, and said cutter section of the sequin feed unit is provided at a distal end of said support plate, and

said adjustment mechanism of each of said sequin feed units adjusts the cutting position, where said cutter section cuts the sequin off from the sequin strip, by linearly displacing said support plate of the sequin feed unit.

5. A sequin feeder apparatus as claimed in claim **3** wherein said adjustment mechanism of each of said sequin feed units includes a mechanism for linearly displacing the whole of said sequin feed unit.

6. A sequin feeder apparatus as claimed in claim **5** wherein said mechanism for linearly displacing the whole of the sequin feed unit includes a mechanism for converting rotation of an adjustment screw into linear displacement of the sequin feed unit.

7. A sequin feeder apparatus as claimed in claim **1** wherein said cutter section of each of said sequin feed units includes a fixed cutter blade and movable cutter blade that operate independently of the fixed cutter blade and movable cutter blade of the other sequin feed unit.

8. A sequin feeder apparatus as claimed in claim **1** wherein said sequin feed mechanism of each of said sequin feed units is capable of setting a sequin feed amount independently of the sequin feed mechanism of the other sequin feed unit.

9. A sequin feeder apparatus as claimed in claim **8** wherein said drive mechanism drives said sequin feed mechanism of the one sequin feed unit, currently positioned in the predetermined sewing operation position, with a drive amount corresponding to the sequin feed amount set by said sequin feed mechanism of the one sequin feed unit.

10. A sequin feeder apparatus as claimed in claim **1** wherein said at least two sequin feed units are disposed side by side in such a manner that said sequin feed units are slidable together, and

said sequin selection mechanism positions one of said at least two sequin feed units in the predetermined sewing operation position by sliding said at least two sequin feed units together.

11. A sequin feeder apparatus as claimed in claim **1** wherein said drive mechanism includes:

an engagement portion for engaging with said sequin feed mechanism of the one sequin feed unit positioned in the predetermined sewing operation position;

a motor drivable in interlocked relation to the sewing operation; and

a link mechanism for transmitting motion of said motor to said engagement portion, and

wherein said sequin feed mechanism of the one sequin feed unit positioned in the predetermined sewing operation position is caused to operate, in response to the motion of said motor and via said link mechanism and said engagement portion, to thereby feed the continuous sequin strip toward the predetermined cutting position.

12. A sequin feeder apparatus as claimed in claim **1** wherein said cutter section of the one sequin feed unit positioned in the predetermined sewing operation position is

driven, in response to movement of a needle bar during the sewing operation, to thereby cut a sequin off from the continuous sequin strip.

13. A sequin feeder apparatus as claimed in claim **1** which further comprises a detection device for detecting whether or not a supply of the continuous sequin strip from a sequin strip supply source to any of said sequin feed units has run out.

14. A sequin feeder apparatus as claimed in claim **1** wherein each of said sequin feed units is detachably attached to a base section of said sequin selection mechanism.

15. A sewing machine comprising the sequin feeder apparatus, recited in claim **1**, in association with a sewing head.

16. A sewing machine as claimed in claim **15** wherein different continuous sequin strips of at least two types are supplied from the sequin strip supply sources to the at least two sequin feed units, and

which further comprises a control device that, on the basis of sewing pattern data of a desired sequin pattern that uses at least two types of sequins in combination, controls the sequin selection mechanism to select any one of said at least two sequin feed units at a particular sewing position where the sequin to be used is to be changed from one type to another, said control device then performing control such that sequin sewing is performed using the selected sequin feed unit.

17. A sewing machine as claimed in claim **16** wherein the desired sequin pattern comprises a pattern to be made by alternately selecting and sewing the at least two types of sequins.

18. A sewing machine as claimed in claim **16** wherein the desired sequin pattern comprises a pattern to be made by alternately selecting and sewing the at least two types of sequins in overlapped relation to each other.

19. A sequin feeder apparatus comprising:

a sequin feed unit including a sequin feed mechanism for feeding a continuous sequin strip toward a predetermined cutting position and a sequin-cutting cutter section located in the predetermined cutting position;

a drive mechanism for driving, in response to a sewing operation, the sequin feed mechanism to feed the continuous sequin strip toward the predetermined cutting position, the cutter section being driven, in response to the sewing operation, to cut a sequin off from the continuous sequin strip having been fed to the predetermined cutting position;

a displacement member provided between a sequin strip supply source and the sequin feed unit and displaceable between a first position and a second position, said first position being where said displacement member is held stationary in abutting contact with the continuous sequin strip supplied from the sequin strip supply source to the sequin feed unit, said second position being where, due to absence of the continuous sequin strip, said displacement member is located past said first position without abutting against the continuous sequin strip; and

a detection device for detecting that said displacement member has shifted from said first position to said second position,

wherein that a supply of the continuous sequin strip has run out is detected on the basis of an output of said detection device.

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