

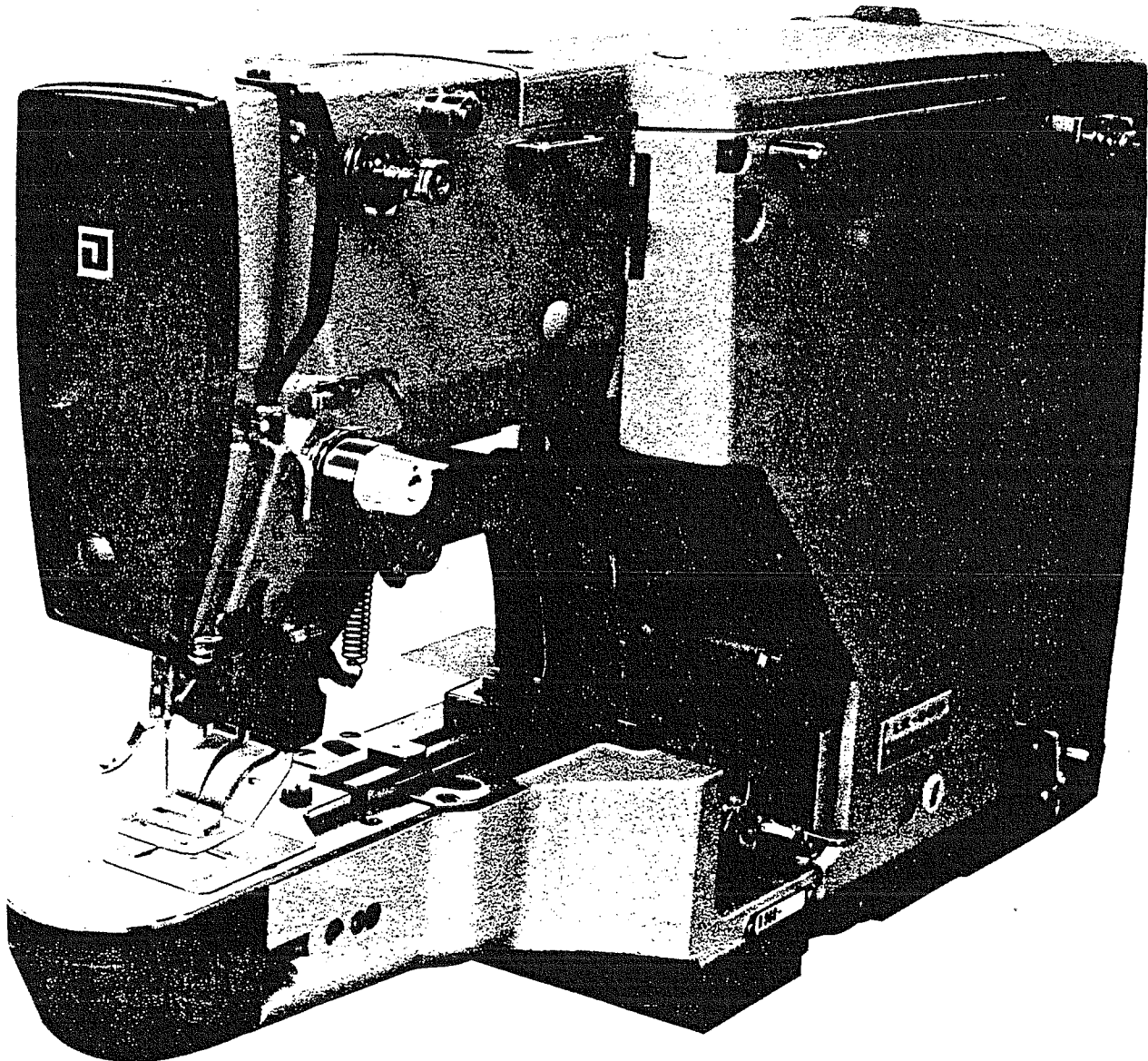
**JUKI**

Bar Tacker

# LK-980 Series

## ENGINEER'S MANUAL

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NO. IV-8-1  
1988. 4

## INTRODUCTION

This booklet consists mainly of 3 parts, the first part is for the "Standard Adjustments" covering the basic adjustments and their directions, the second part is for elimination of mechanical troubles and the third part is for the subclass models of the LK-980 series.

We hope all service engineers will read and study carefully the first part "Standard Adjustment."

The "Standard Adjustment" explained in simple terms with illustrations will facilitate quick access to the practical services for service engineers in the field. The columns "Possible problems or phenomena caused by improper adjustments" and "Corrections" are added for inexperienced service engineers.

To make optimum use of this booklet, we advise you to refer to "PARTS BOOK for the LK-980 series."

If the brief descriptions given in "Standard Adjustment" are not enough, refer to the relative item for further details.

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# I. STANDARD ADJUSTMENTS

## Standard adjustments

### (1) Needle and sewing hook

#### 1) Height of the needle bar

When the needle bar has reached its lowest position, the upper engraved line on the needle bar must align with the bottom end of the needle bar bushing (lower).

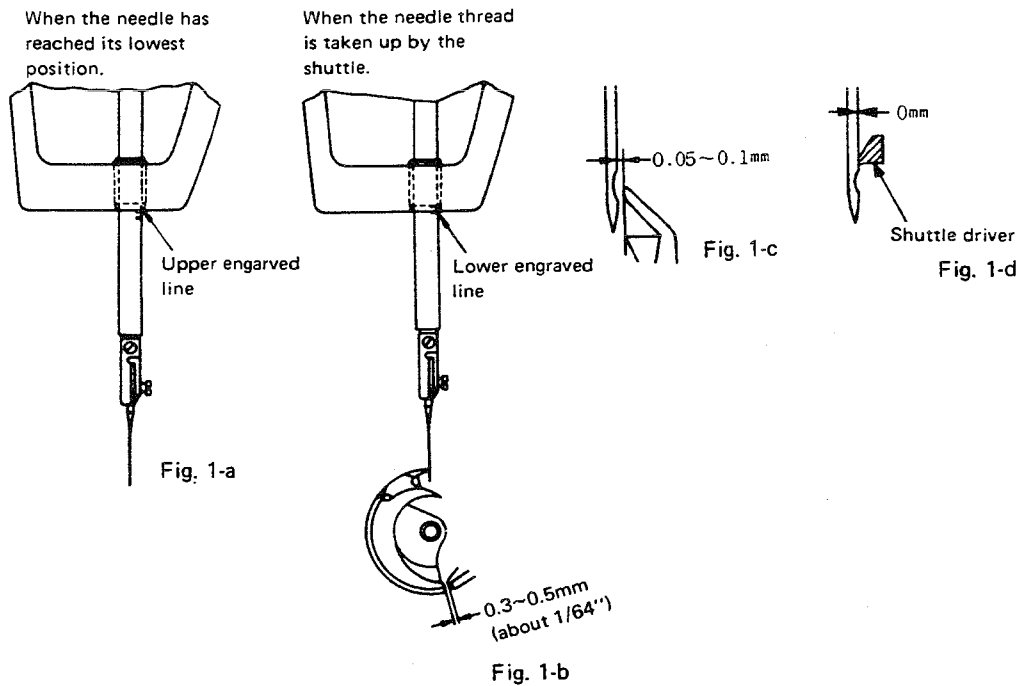
#### 2) Shuttle

With the above needle bar position, the pointed end of the shuttle must align with the needle center.

#### 3) Clearance between the needle surface and the shuttle must be 0.05 to 0.1 mm.

#### 4) There must be no clearance between the needle and the shuttle driver. The top end of the shuttle driver prevents the needle from bending as shown in Fig. 1-b.

#### 5) Clearance between the top end of the shuttle driver and the shuttle must be 0.3 to 0.5 mm (about 1/64").



Note: Adjustments of "Height of the needle bar" and "shuttle" may vary in some subclass models

### (2) Feed cam

Adjust the cam so that the cloth feed motion is completed when the needle point has come down 7 to 10 mm (9/32" to 25/64") above the throat plate surface.

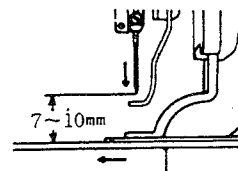
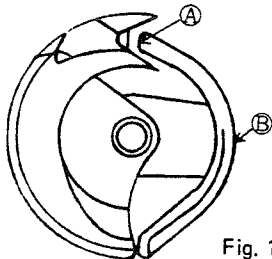


Fig. 2

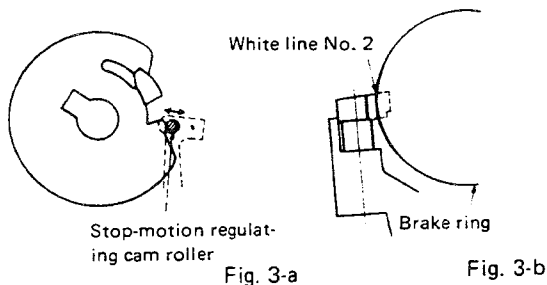
Possible troubles and phenomena caused by improper adjustments	Corrections
<p>(1) When sewing materials which tend to flutter while being stitched, set the needle bar slightly lower than the standard height. When sewing a heavy-weight material, providing it is not of a type that tends to flutter, set the needle bar slightly higher than the standard height.</p>	<p>See "3. Needle Bar Components" in the Parts Book. Remove the face plate and adjust the needle bar height by loosening screw (SS-6090670-TP) of needle bar connection.</p>
<p>(2) When using a synthetic or soft and thin thread (for example, cotton thread #80), in order to prevent it from falling down and snagging, do not allow it to form a large loop.</p>	<p>See "5. Shuttle Driver Shaft Components" in the Parts Book. Loosen screw (SS-6121212-TP) and adjust the shuttle driver.</p>
<p>(3) If the shuttle comes closer to the needle than 0.05 mm, they may touch and scratch each other. The scratches on their surfaces will damage a thin or synthetic thread. If the clearance is greater than 0.1 mm stitch-skipping will result.</p>	<p>See "5. Shuttle Driver Shaft Components" in the Parts Book. Loosen screw (SS-6151220-SP) to set free shuttle race and adjust the shuttle race position in the axial direction by turning shuttle race adjusting shaft (B1819-280-000)</p>
<p>(4) If the shuttle driver doesn't come into close contact with the needle, the needle will bend backwards. The bent needle will hit the blade point of the shuttle scratching them both. If this happens the thread is likely to be broken or torn by these scratched surfaces. If the needle is only slightly bent, stitching will not be affected. If, however, it is bent too much, it may cause stitch-skipping.</p>	<p>Loosen screw (SS-6121212-TP) and adjust shuttle driver in the axial direction by taking care not to turn the shuttle driver in the direction of rotation. If you mistakenly allow the shuttle driver to rotate, readjust the shuttle according to 2).</p>
<p>(5) If the clearance between the shuttle driver and the shuttle is greater than 0.3 to 0.5 mm (about 1/64"), a noise will result during operation. If it is too small, a thick thread may fail to be drawn out resulting in formation of a loose stitch.</p>	<p>Although each end of the shuttle driver is hardened, you can bend it at the middle point when adjusting the clearance at the shuttle. Remove the shuttle from the shaft for bending, otherwise the shuttle may shake on the shaft when rotating. Also take care to keep point A at an equal distance from each lip of the shuttle, in order to let the thread pass through smoothly. It is advisable to tap the shuttle at the point B.</p>  <p style="text-align: right;">Fig. 1-e</p>
<p>If the needle point height is set closer to 7 mm (9/32"), the stitch will be tightly formed. When the needle point height is set closer to 10 mm (25/64"), it prevents synthetic needle thread from coming out on the surface of the material and forming an idle loop on the first stitch. (No special care is needed for sewing heavy-weight material)</p>	<p>See "6. Feed Cam Components" in the Parts Book. Loosen nut (NS-6360621-SN) and also loosen feed cam position stud (B2207-280-000). Now the feed cam can be freely adjusted in the normal direction of rotation. (Note) (Once you have adjusted the feed cam position, you should not change it afterwards. If changed, you must readjust the thread tension release components and the stop-motion regulating cam (Refer to the relevant paragraphs in this Manual.)</p>

Standard adjustments

(IMPORTANT) The following adjustment, from (3) to (7), must without exception, be made in the stipulated order.

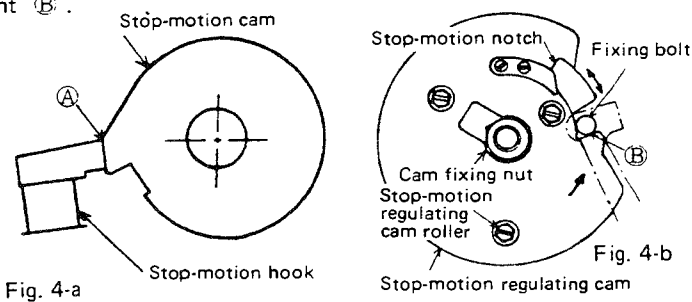
**(3) Position of the stop-motion hook**

During low-speed rotation, the white line No. 2 on the stop-motion hook must coincide with the periphery of the brake ring.



**(4) Position of the stop-motion regulating cam (to start stitching)**

Align the top surface of the stop-motion hook with the stop-motion regulating cam at point A and fix the stop-motion regulating cam by pressing the cam roller against point B.



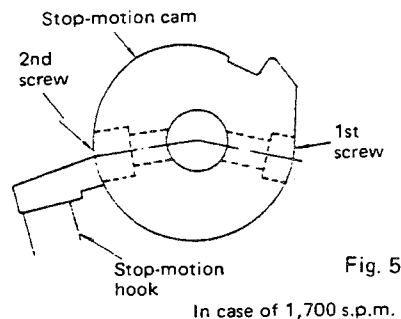
**(5) Stop-motion notch**

The timing to let the roller drop and rest in the stop-motion cam after the last stitch is sewn is determined by the position of the stop-motion notch.

Provide the stop-motion notch with a proper position by moving it up or down, according to the sewing speeds as listed below, when the last stitch is sewn and the top edge of the stop-motion hook touches the stop-motion cam.

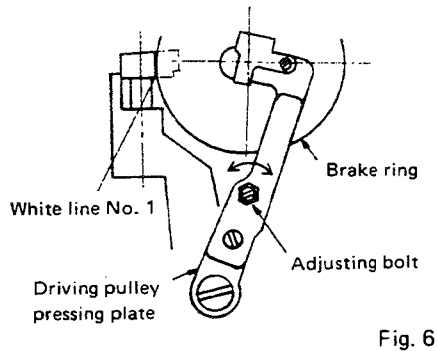
**Position of the stop-motion hook**

- At 1,700 s.p.m. Center of the 2nd screw.
- At 2,000 s.p.m. Between the 1st and the 2nd screws.
- At 2,200 s.p.m. Center of the 1st screw.



**(6) Driving pulley pressing plate**

The driving pulley pressing plate must be adjusted so that the machine starts running when the white line No. 1 coincides with the periphery of the brake ring.



	Possible troubles and phenomena caused by improper adjustments	Corrections
	<ul style="list-style-type: none"> <li>● If white line No. 2 enters into the periphery too far, the stop-motion hook may hit the regulating cam. This will cause noise and the low speed cork ring will slip due to insufficient engagement.</li> <li>● If white line No. 2 is too far out from the periphery, the motion of the thread trimmer cam roller may be hindered, resulting in thread trimming failure.</li> </ul>	<p>Loosen nut (NS-6150430-SP) and adjust the position of stop-motion regulating cam shaft (B2614-280-000) in the direction shown by the arrow. Since this nut tends to loosen during operation, tighten it securely after adjustment.</p>
		<p>See "9. Stop-motion Mechanism Components" in the Parts Book.</p> <p>Depress the start pedal and adjust point <b>Ⓐ</b>. Loosen 3 bolts (SS-9151120-CP) and adjust stop-motion regulating cam (B2612-980-000). Loosen the cam fixing nut (NS-6361040-SP) and set cam (B2612-980-000) to point <b>Ⓑ</b>. (Point <b>Ⓐ</b> can be seen through an opening in the brake ring)</p>
	<p>When the motor pulley is changed to vary the sewing speed, this position must be corrected at the same time.</p> <p>(Note) The degree of stop-motion shock depends also on the position of the stop-motion notch. If the sewing machine carries an excessive rotational torque to reduce its sewing speed especially in a cold season, shift the notch position counterclockwise along the circumference to increase the counteraction.</p>	<p>Adjust the position of stop-motion notch (D2630-M8W-B00) as shown in Fig. 4-b.</p>
	<ul style="list-style-type: none"> <li>● If the machine starts running too quickly, the speed reduction ball bearing will slip and make a noise when the machine starts or stops.</li> <li>● If the machine starts running too slowly, the start pedal may become heavy to operate and the clutch may fail to engage firmly, resulting in slipping.</li> <li>● Do not turn too much to the left the adjusting bolt which fastens the driving pulley pressing plate. Stop the machine, turn by hand the driving pulley and ensure that it does not rotate the low speed cork ring and the brake cork ring. If they are rotated, the friction surfaces in the brake components may wear away during operation.</li> </ul>	<ul style="list-style-type: none"> <li>● Adjust the position of driving pulley pressing plate (B2611-980-000) by tightening or loosening bolt (SS-9151420-TP).</li> <li>● Adjust driving pulley pressing plate (B2611-980-000) so that the low speed cork ring (see Fig. 7-b) starts lightly engaging with the driving pulley when the stop-motion hook moves into the periphery of the stop-motion cam to start sewing. (See Fig. 4-b)</li> </ul>

## Standard adjustments

### (7) Stop-motion connecting pin

When the start pedal is depressed to restart, the brake ring must move away by 0.1 to 0.5 mm (about 1/64").

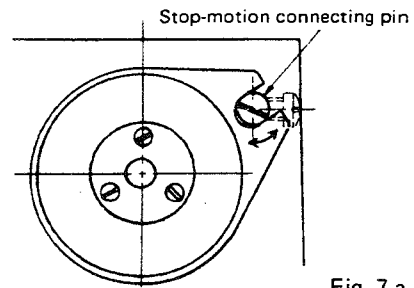


Fig. 7-a

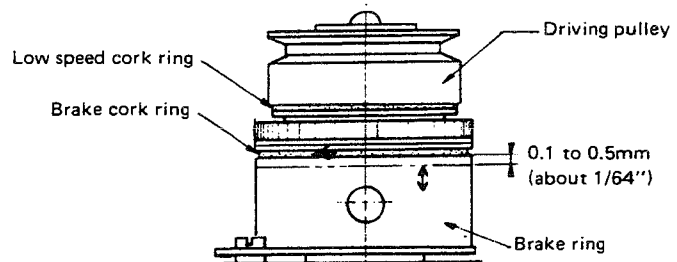


Fig. 7-b

### (8) Position of the safety adjusting plate

When the work clamp foot lifting lever is down in the stop-motion position the safety adjusting plate touches at point A. When the work clamp foot lifting lever is up, the safety adjusting plate has a clearance of 0.3 mm.

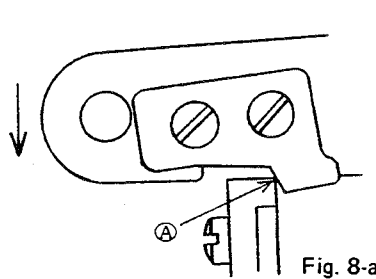


Fig. 8-a

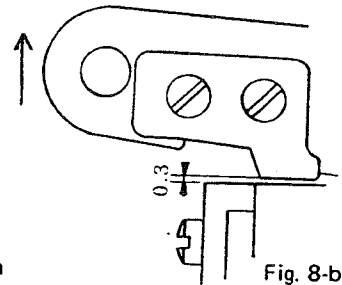


Fig. 8-b

### (9) Position of the shuttle race spring

#### 1) Crosswise position :

The center of the slit must align with the needle point.

#### 2) Lengthwise position :

The edges A of the spring must align with the rear face of the needle.

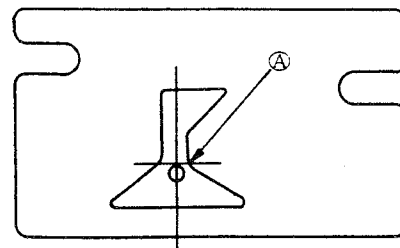


Fig. 9

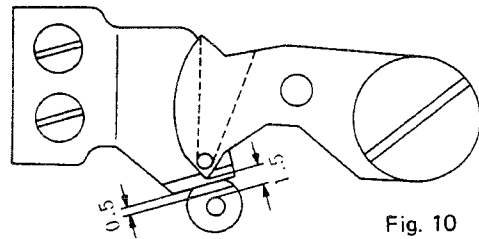


	Possible troubles and phenomena caused by improper adjustments	Corrections
	<ul style="list-style-type: none"> <li>● If the brake ring goes too far, it will make the return of the stop-motion lever incomplete resulting in an incomplete stop-motion. Also, it may fail to release the safety device which locks the work clamp foot.</li> <li>● If the brake ring does not go far enough, stop-motion shock will be increased. In this case, the stop-motion ball may be damaged resulting in noise when the sewing speed is changed from low to high speed.</li> <li>● With a properly adjusted machine, the work clamp foot will perform normal up-and-down motion and the brake cork ring will momentarily rotate in the reverse direction just before stop-motion is completed.</li> </ul>	<p>See "2. Main Shaft Components" in the Parts Book. Loosen screw (SS-6151920-TP) and adjust the position of the "stop-motion" connecting pin (B2623-980-000) in the direction shown by the arrow. After adjustment, check the following point. Bring it into the starting position by turning driving pulley and make sure that brake cork ring idles while the main shaft rotates from 100 to 200° to change the sewing speed from high to low. (However, when sewing many stitches, the idling angle may be in excess of 200°. When sewing canton crepe or other extra-heavy materials, the angle may be reduced down to 100°).</p>
	<ul style="list-style-type: none"> <li>● If there is any clearance at point ④, the wiper will move too early and hit the needle point.</li> <li>● If the clearance is smaller than 0.3 mm, the motion to be performed by the safety adjusting plate will be hindered. If it is too much, the work clamp foot may accidentally go up during operation.</li> </ul>	<p>See "8. Pedal Pressure Decreasing Unit Components" in the Parts Book. Adjust the position of the safety adjusting plate by loosening screws (SS-6111010-TP).</p>
	<p>If the spring does not allow the needle to pass through the above-mentioned point, the needle thread will snag in the sewing hook. If the needle drops too far to the rear, the moving knife may fail to hook the needle thread.</p>	<p>See "5. Shuttle Driver Shaft Components" in the Parts Book. Remove the feed plate and the needle plate and adjust the position of shuttle race spring by loosening 2 screws (SS-6060410-TP).</p>

## Standard adjustments

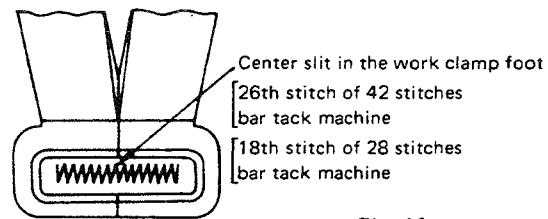
### (10) Thread trimmer

- 1) When the machine is in stop-motion, the distance from the thread hooking point of the moving knife to the nearest end of the needle hole in the needle plate must be 1.5 mm (1/16").
- 2) The distance from the counter knife edge to the needle hole guide on the needle plate must be 0.5 mm (1/64").



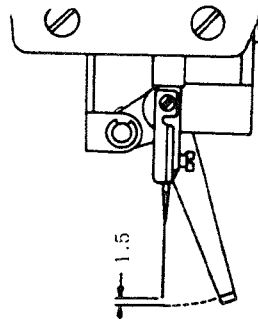
### (11) Position of the work clamp foot

- 1) Large bar tacking machine (42 stitches) :  
The 26th stitch must be aligned with the center slit in the work clamp foot.
- 2) Large bar tacking machine (28 stitches) :  
The 18th stitch must be aligned with the center slit in the work clamp foot.



### (12) Position of the wiper

The wiper clearance at the needle point must be 1.5 mm (1/16") when the wiper passes under the needle point.

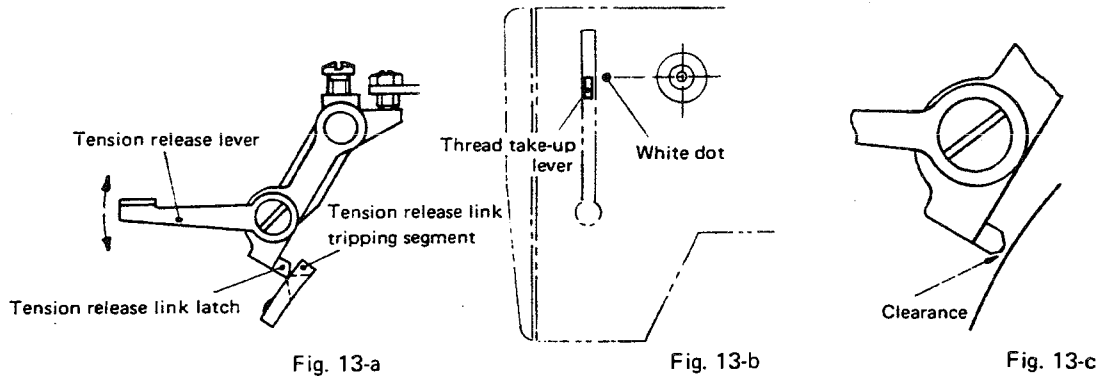


	Possible troubles and phenomena caused by improper adjustments	Corrections
	<p>If the needle thread being released from the hook blade at the last stitch is too tight, add a slight distance to the stipulated "1.5 mm". When using a thick thread, slightly reduce the "1.5 mm" distance. As the "0.5 mm" distance is increased, the bobbin thread length from the bobbin case pawl will become shorter and the bobbin thread will skip the first stitch.</p>	<p>See "3. Needle Bar Components" in the Parts Book. Loosen screw (SS-7110740-TP) and adjust the position of the moving knife driving lever (B2415-280-0A0) to front or rear.</p>
	<p>If not correctly adjusted, it will make the buttonhole positioning work harder.</p>	<p>See "6. Feed Cam Components" in the Parts Book. Loosen nut (NS-6660511-SP) which fastens feed cam roller shaft and adjust the position. See also page 30.</p>
	<p>If the clearance is not enough, the wiper may hit and break the needle point. If the clearance is too much, the needle clamp screw will touch the wiper.</p>	<p>See "4. Thread Tension Release Components" in the Parts Book. Loosen screw (SS-7110840-SP) of wiper installing plate (B2102-280-000) and adjust the height of the wiper. Also refer to the relevant paragraph on page 32.</p> <div data-bbox="991 1417 1445 1669" data-label="Diagram"> </div> <p>(Note) The stop-motion cam can move freely within the limit of clearance (a) after the stop-motion mechanism activates. But, when adjusting, never fail to push the stop-motion hook against the face ① .</p>

## Standard adjustments

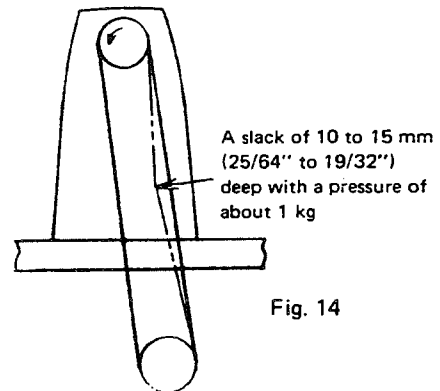
### (13) Timing of thread tension release

- 1) When the machine is in stop-motion position, the tension release link latch must rest on top of the tension release link tripping segment.
- 2) When, on completion of the last stitch, the highest point of the ascending thread take-up lever has reached the level shown by a white dot on the machine arm, tension disc No. 2 must start releasing the thread.
- 3) While stitches are being made, the tip of the tension release link latch must not touch the periphery of the rotating feed cam.



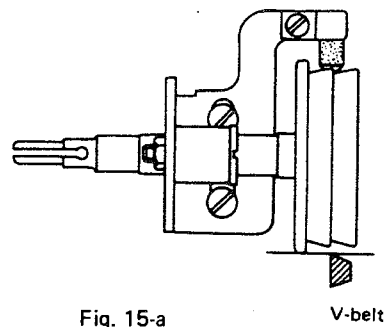
### (14) V-belt tension

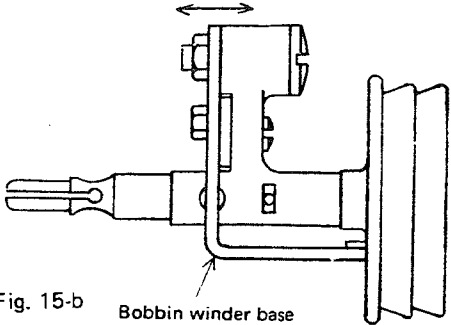
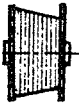

When the middle point of the V-belt is pressed with the finger (pressure of about 1 kg), it should have a slack of 10 to 15 mm in depth ( $25/64''$  to  $19/32''$ ).



### (15) Position of the bobbin winder

When the bobbin winder is not operated, the bobbin winder wheel must be kept apart from the V-belt so that the periphery of the wheel rim is at the level of the edge of the V-belt.



Possible troubles and phenomena caused by improper adjustments	Corrections										
<p>1) If the tension release link latch is far below the top of the tripping segment, the first stitch may become loose. If it goes up too high above and runs through the segment, it will fail to perform the action explained in 2).</p>	<p>See "4. Thread Tension Release Components" in the Parts Book. Loosen screws (SS-7090520-TP) and adjust tension release link tripping segment (B2304-980-000).</p>										
<p>2) If the thread tension release system works too quickly, the length of trimmed thread may become uneven and long. If it works too slowly, the length of trimmed thread may become short and may slip out of the needle eye.</p> <p>Hints on adjustment</p> <table border="1" data-bbox="282 590 806 837"> <thead> <tr> <th>Needle thread</th> <th>Tension release lever</th> </tr> </thead> <tbody> <tr> <td>Too long</td> <td>Turn up</td> </tr> <tr> <td>Uneven</td> <td>Turn up</td> </tr> <tr> <td>Too short</td> <td>Turn down</td> </tr> <tr> <td>Broken or slipping out</td> <td>Turn down</td> </tr> </tbody> </table>	Needle thread	Tension release lever	Too long	Turn up	Uneven	Turn up	Too short	Turn down	Broken or slipping out	Turn down	<p>Next to thread guide No. 1, there is an adjusting hole for hinge screw. (SD-0500481-TP) to set tension release link latch. Insert a screw driver into the adjusting hole and slightly loosen the hinge screw. You will then be able to adjust the timing of the thread release by changing the position of the tension release lever (B2308-980-0A0) according to the directions given above.</p>
Needle thread	Tension release lever										
Too long	Turn up										
Uneven	Turn up										
Too short	Turn down										
Broken or slipping out	Turn down										
<p>3) If the tension release link latch touches the periphery of the feed cam during operation, it will be worn down causing variation in the thread release timing, resulting in thread trimming failure.</p>	<p>Adjust the tension release link latch by turning screw (SS-8151150-TP).</p>										
<ul style="list-style-type: none"> <li>● If the V-belt tension is too high, the driving pulley will not slip correctly and the stop-motion shock will be considerably increased.</li> <li>● If the V-belt tension is too low, the sewing speed will decrease and the machine will stop a little before the correct stop-motion position.</li> </ul> <p>(Caution) Be sure to position the pressure decreasing belt of the tension pulley. If the belt tension is too low, the unit may fail to work properly.</p>	<p>See "11. Table Components" in the Parts Book. Adjust the tension of V-belt by changing the height of motor base assembly.</p>										
<p>If the bobbin winder wheel is positioned too close to the V-belt, it may be accidentally turned or rubbed by the V-belt. If it is too far from the V-belt, it may fail to wind the bobbin.</p>  <p>Fig. 15-b Bobbin winder base</p>	<p>See "3. Needle Bar Components" in the Parts Book.</p> <ol style="list-style-type: none"> <li>1) Adjust the position of bobbin winder base by loosening screws (SS-7151210-SP).</li> <li>2) If bobbin winder spindle is rotated while the bobbin winder is not in use, loosen screw (SS-7110510-SP) on pressure plate and push out bobbin winder brake (B3209-280-000).</li> <li>3) If the bobbin winder fails to wind the thread evenly, carefully correct the angle of bobbin winder base (B3201-280-000) by using a pair of pliers.</li> </ol>   <p>Fig. 15-c Bend it to the left      Bend it to the right</p>										

**(16) Rotating the machine by hand**

You will not be able to depress the start pedal, even if you try to rotate the machine by hand. Detach spring (B2629-980-000) (see "9. Stop-motion Mechanism Components" in the Parts Book) from the upper anchor, rotate driving pulley 2 or 3 turns to bring down the work clamp foot and depress the start pedal.

**(17) Motor pulley and driving belt**

Even though adequate tension is produced by the pair of belts as listed below, use the tension pulley (B7805-980-0A0) (see Parts Book p. 19) as well.

Take care not to allow the belt tension to change during rotation, as change of tension would seriously impair performance.

The power frequency and rate of revolution are inscribed on each pulley.

Frequency	Sewing speed (s.p.m.)	Maximum dia. of motor pulley (φ, mm)		Driving belt		Pressure decreasing belt	
50 Hz	2200	112.5	B7101980000	48 "	MTJVM004800	35 "	MTJVM003500
	2000	99.5	B710198000B	47 "	MTJVM004700	34 "	MTJVM003400
	1700	87.5	B710198000C	46 "	MTJVM004600	34 "	MTJVM003400
	1400	73.0	B710198000D	46 "	MTJVM004600	35 "	MTJVM003500
60 Hz	2200	94.6	B7102980000	47 "	MTJVM004700	34 "	MTJVM003400
	2000	84.0	B71029800GB	46 "	MTJVM004600	34 "	MTJVM003400
	1700	74.0	B710298000C	46 "	MTJVM004600	35 "	MTJVM003500
	1400	59.5	B710298000D	45 "	MTJVM004500	35 "	MTJVM003500

(Note) For a sewing speed of less than 1,400 s.p.m., stop-motion regulating cam (D1214-M7X-C00) specially designed for low speed operation must be used.

For operation at a speed of 1,400 s.p.m. with power frequency of 60 Hz, idler pulley (B7801-280-0A0) must be used.

**(18) Needle sizes and needle plate needle hole guides suitable for different types of material**

Material type	Needle size	Needle plate needle hole guide		Garments
Fine	DP x 5 #11	D2426-282-C00		Knits, tricot, underwears
Synthetic	DP x 5 #14 (Super needle)	B2426-280-000 Small, large and buttonhole bar tacking	D2426-284-M00 Shape bar tacking	Men's suits, Ladies' suits, Casual wears
Standard	DP x 5 #16			
Heavy-weight	DP x 5 #18			Working wear, Coat
Extra-heavy	DP x 5 #19 ~ #21 *DP x 17 #18 ~ #21	B2426-280-00B		Jeans, heavy winter wear

(Note) Do not use needle LQ x 5 which has been installed in the conventional model LK-232.

(\*) When using a DP x 5 needle for sewing heavy-weight materials, use the following parts at the same time;

Needle bar D1401-L7V-V00  
Needle bar thread guide D1405-L7A-M00

For sewing heavy denims, refer to the table in paragraph (4) Use of the Special Parts, page 42, "When a thick needle is used" and "When a thick thread is used."

**(19) Other possible troubles**

- 1) If you depress the start pedal rapidly, the machine may fail to start.  
Depress the start pedal slowly so that the work clamp foot comes down to release the machine from the safety device.
- 2) When the machine stops after the needle has come down to sew the first stitch;  
Depress the start pedal fully downwards.  
If this trouble occurs frequently, adjust the stop-motion regulating cam by moving it slightly in the direction of rotation. (Reduce the stop-motion shock by referring to (11) and (12).)
- 3) When operating the machine at a speed of 2,200 s.p.m. or using a thick thread, manually apply a little more lubricating oil to the shuttle race.

**(20) Installing method of LK-980 driving pulley pressing plate**

1. Mounting the driving pulley pressing plate in the following order (Fig. A):

- 1) Unscrew the hexagonal head screw ① and screw ③, remove the washer ② and remove the previously installed grease box ④. (Removed hexagonal head screw and the washer are to be disposed of.)
- 2) Apply grease to the ball A and the top portion B of the new driving pulley pressing plate (small) ⑤.
- 3) Fix the new grease box and driving pulley pressing plate (small with the new screw (hinge screw SD-0800402-TP) ① and then mount the combination to the stop-motion lever ⑦ and fasten it with screws ① and ③.

2. Adjustment of the driving pulley pressing plate (Fig. A, B)

- 1) Turn the driving pulley ⑩ by hand in the direction of an arrow (←) given in Fig. A when the outer periphery of the brake ring ⑧ fits the first white line of stop-motion hook ⑨, adjust the screw ⑥ so that the clutch starts operation and the machine begins running, adjust the grease box in the direction of (→) in Fig. B and then fasten it with the nut. (Note that timing after varies if the nut is fastened.)
- 2) Ensure always that the slow speed cork ring ⑪ and brake cork ring ⑫ don't rotate during operation of the brake ring while the machine is suspended.  
Readjust the screw ⑥ since it causes wearing accidents of the reduction gear if the slow speed cork ring ⑪ and brake cork ring ⑫ are rotating.

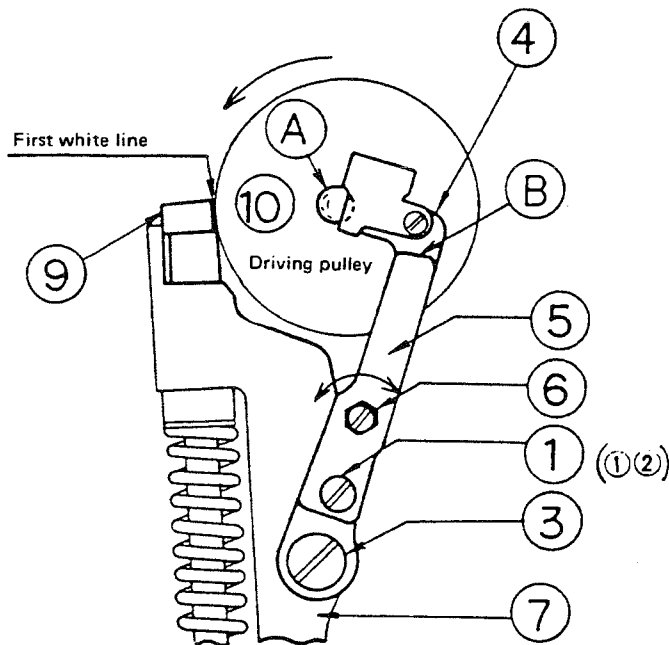


Fig. A

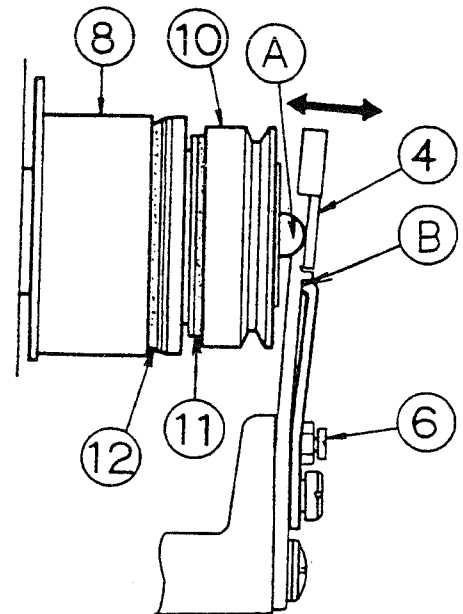


Fig. B

## II. MEASURES TO ELIMINATE STITCHING FAILURES

This chapter covers stitching failures and their corrective measures, e.g. thread escape, thread breakage, stitch-skipping, needle breakage, thread trimmer failure and related problems.

### (1) Thread escape

Phenomenon . . . . . The machine fails to form the first, second or third stitches and the thread slips out of the needle eye.

- Possible causes . . . . .
- The first stitch was skipped.
  - The thread left in the needle eye before starting was too short.
  - The thread take-up spring was not properly adjusted.
  - The bobbin thread was too short.

#### Corrective measures

1) To prevent the first stitch from being skipped

A. Check the relative position of the shuttle to the needle.  
Readjust it, if necessary.

B. Correct the clearance between the needle and the shuttle. Set the shuttle race free by loosening the setscrew. Reduce the clearance to 0.05 to 0.1 mm by turning the shuttle race adjusting shaft. Take care not to make the clearance smaller than stipulated, or the two may touch, which would cause wear. (Fig. 16)

C. Allow the shuttle to rotate smoothly.  
Provide the shuttle with a lapping finish so that it rotates smoothly in the shuttle race. Thoroughly clean the inside surface of the shuttle race and remove all fibrous dust and lints.

D. Prevent the material under the work clamp foot from fluttering. A special set of work clamp components by which the material can be securely clamped in a "U" shape (as shown in Fig. 17) prevents the material from fluttering while stitching. Large-size bar tacking components designed for knit goods are available;

- Feed plate                      B2519-280-00B
- Work clamp foot (right) B2551-280-00B
- Work clamp foot (left) B2552-280-00B

E. Check if the feed cam is synchronized with the needle.

When the needle starts stitching the material, the feed cam must stop feeding the material.

If the needle is carried away by the material, you must loosen the feed cam positioning pin and adjust the feed cam timing. After adjusting the feed cam, correct the positions of the stop-motion regulating cam and the tension release link tripping segment accordingly. (Fig. 18)

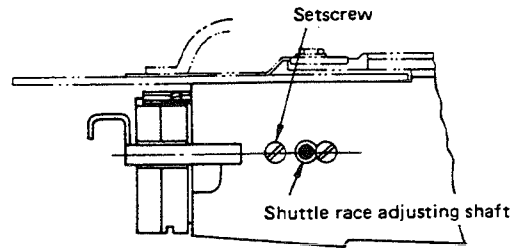


Fig. 16

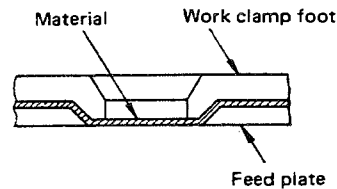


Fig. 17

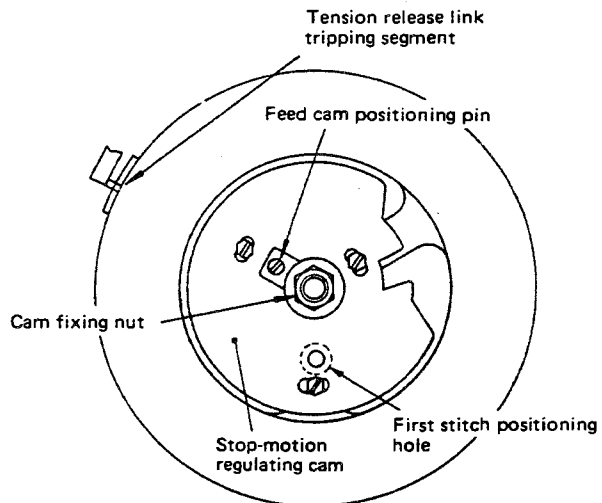


Fig. 18



- 2) Adjust the machine to leave a longer needle thread after trimming.

If the needle thread left in the needle eye after trimming is too short, it will slip out of the needle while the first stitch is being formed.

A. The standard length of the needle thread left in the needle after trimming is 35 to 40 mm (1-3/8" to 1-37/64").

B. If the thread tension is released too late, the remaining needle thread will become too short and may spring out of the needle. Correct the thread release timing by means of the tension release lever. If the timing is too fast, the thread length will be uneven or too long (See standard adjustment (13)).

C. If the tension disc No. 1 is too tight, the thread left in the needle eye will become too short.

D. If the counter knife position is too high, it will cut the thread before the moving knife arrives in the cutting position. If this happens neither the needle and bobbin thread lengths will be enough to start the following stitch. The bottom surface of the counter knife must be positioned 0.1 to 0.15 mm lower than that of the needle plate needle hole guide (Fig. 20).

E. As mentioned in the standard adjustment (10) "Thread Trimmer", when the machine is in the stop-motion position, the thread hooking point of the moving knife must be 1.5 mm (1/16") away from the nearest end of the needle hole in the needle plate. If the distance is greater than 1.5 mm (1/16"), a shorter needle thread will be left in the needle.

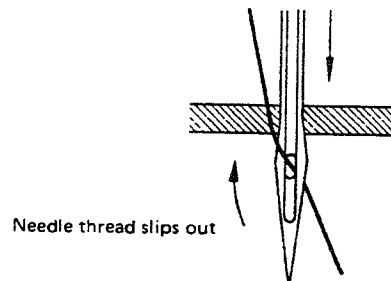


Fig. 19

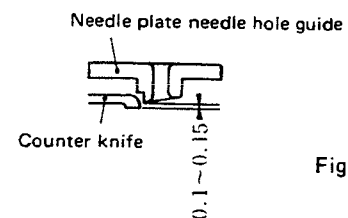


Fig. 20

- 3) To adjust the thread take-up spring (Fig. 21)

A. If the stroke of the thread take-up spring is too great, it may draw in the needle thread immediately after the thread is cut. Thus, the thread left in the needle eye will be too short and will slip out.

B. To reduce the stroke of the thread take-up spring, loosen the bolt to set tension controller No. 2 and turn the entire tension controller in the anticlockwise direction.

C. To increase the stroke of the thread take-up spring, loosen the setscrew of the tension post, insert a screw driver blade into the tension controller in the way shown by the arrow and turn it anticlockwise.

D. Tighten the setscrew and bolt of tension controller No. 2 securely. If they are not firmly fixed in position, the tension disc will fail to release the thread and allow it to jump up out of the needle eye.

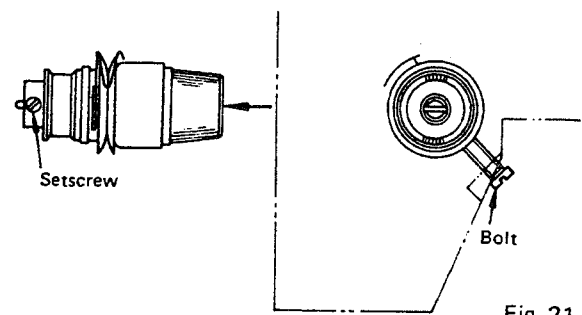


Fig. 21

(Note) When the tension disc releases the thread, make sure that the tension release pin meets the tension release rod at the rising part of the tension release bar. If they meet at the upper straight part, the tension release bar may fail to return. (Fig. 22)

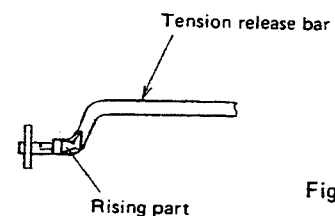


Fig. 22

4) Bobbin thread is too short.

A. If the bobbin thread extending from the top end of the bobbin case finger is less than 22 mm (7/8"), the machine may fail to form stitches (Fig. 23). Provide a little more distance between the counter knife and the needle plate needle hole guide.

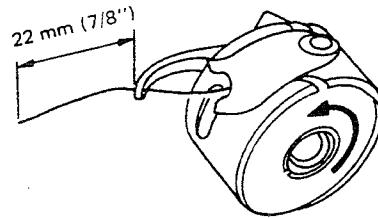


Fig. 23

B. If the vertical distance between the needle plate needle hole guide and the counter knife is too much, the thread may come into contact with the counter knife and may be broken.

C. If there is any burr or scratch on the shuttle surface race spring at point A, it may cut or break the bobbin thread. Make part A smooth by the use of abrasives. (Fig. 24)

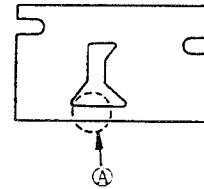


Fig. 24

D. In order to prevent the bobbin thread from coming out due to idle spinning of the bobbin, use both the bobbin and bobbin case specially designed for the LK-980 model.

(2) Thread breakage

(1) Thread breakage when sewing

Phenomenon . . . . . Either the bobbin or the needle thread is accidentally cut while stitching.

- Possible causes . . . . .
- The shuttle is scratched.
  - The thread is snagged in the shuttle.
  - The shuttle driver is scratched.
  - The shuttle driver is too close to the shuttle.
  - The needle plate needle hole guide is scratched.
  - The needle is touching the work clamp foot.
  - The needle is scratched.
  - The needle thread tension at the time of piercing the material is too high.
  - Timing of the feed cam motion is not correct.

Corrective measures

1) Scratched shuttle (Fig. 25)

A. If the needle hits the shuttle, the blade point A will be worn to a knife edge. Carefully polish it with an oilstone and abrasives and keep it slightly away from the needle point. However, do not push it back too far from the needle to prevent stitch-skipping. Also, take care not to provide too much clearance between the front face of the shuttle driver and the needle when the needle bar has reached its lowest position, in order to prevent the needle from bending. In such a case, adjust the shuttle driver position in the axial direction, so that it protects the needle. When the blade point of the shuttle has been seriously damaged, also check to see if the shadowed area (Fig. 26) on the rear face of the shuttle race is of the correct shape as illustrated. If not, correct the shape with an oilstone.

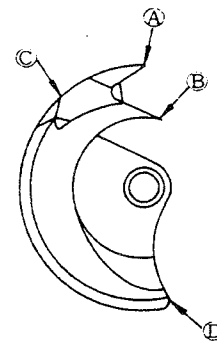


Fig. 25

B. If the needle is bent or broken, the shuttle may be damaged at point B. This scratch may damage or break the needle thread when releasing. This is the most frequent cause of this type of trouble.

C. A scratch at point C can only be made by a broken needle or by careless handling of the needle when replacing the shuttle. However, if the shuttle has a scratch at this point, the machine will probably not be able to stitch.

D. A scratch at point D may damage the thread when releasing and result in thread breakage. This kind of trouble does not occur frequently except with synthetic thread.

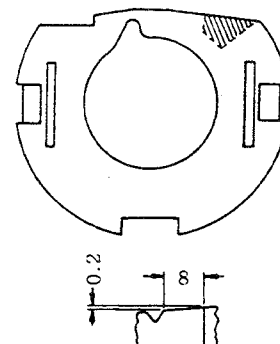


Fig. 26

2) Thread entangled in the shuttle

A. If the shuttle race spring is not properly positioned, it will not handle the thread properly, resulting in thread entanglement. Place the spring in the correct position as shown in Fig. 9.



B. If the radius of the shuttle tip is too large, the thread will snag in the shuttle. Replace such a shuttle. (Fig. 27)



Fig. 27

C. The shuttle race must be positioned in relation to the needle, as shown in Fig. 28, so that there is a clearance  $B$  of 7.5 mm (19/64") between them. If the clearance  $B$  is smaller, the needle thread will tend to snag.

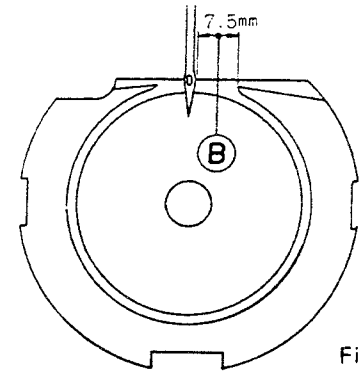


Fig 28

D. If the needle thread tension is too low, the thread will tend to snag.

3) Scratched shuttle driver

Make sure that the shuttle driver does not have any scratches at all on its thread paths. Smoothness of the shuttle race surface is always important, especially for high speed operation. The side edges  $A$  shown in Fig. 29 must be smooth enough to allow the thread to pass over them.

4) Clearance between the shuttle driver and the shuttle is too small.

A. The standard clearance between the shuttle driver and the shuttle is 0.3 to 0.5 mm (about 1/64"). If the clearance is smaller than that, it will not allow the needle thread to smoothly pass and will cause thread breakage or will leave an excessively long thread in the needle eye. On the other hand, if the clearance is too large, the shuttle race will make a noise. (Fig. 29)

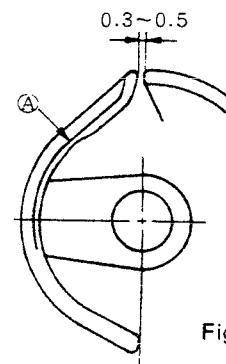


Fig. 29

B. Since there may be some cases where the above-mentioned clearance is slightly different for hooking in and releasing the thread, provide the correct clearance for release.

5) Needle plate needle hole guide

Every time a needle is broken, the needle plate needle hole guide is scratched. Remove such scratches from the surface. Apply some abrasives to a strong thread and polish the scratched surface with it.

6) Needle touches the work clamp foot

A. This does not happen often. If the work clamp foot is not installed in the correct position, the needle may touch its inner face and break the needle thread when stitching with a comparatively large feed pitch.

B. If the work clamp foot is scratched by a needle, make its surface smooth with emery paper.

7) Scratched needle

A scratched needle will break the thread.

Ensure that the needle has a correct clearance at the shuttle blade point and is protected by the shuttle driver. Use needle DP x 5 with LK-980 instead of needle LG x 5 which has been used with the conventional model LK-232, because needle LG x 5 is easily scratched and may cause thread breakage.

8) Needle thread tension is too high when the needle sticks in the material.

Adjust the thread take-up spring so that the stroke is reduced to 6 to 8 mm (15/64" to 5/16") and the initial pressure is 30 to 50 g.

**(2) Thread breakage when trimming**

Phenomenon . . . . . Either the needle or the bobbin thread is accidentally broken while they are being trimmed.

- Possible causes . . . . .
- Thread release timing is not adequate.
  - Moving knife is scratched.
  - Height of the counter knife is not correct.
  - Shuttle race spring is scratched.
  - The bottom surface of the needle plate needle hole guide is not smooth.
  - Position of the moving knife is wrong.

**Corrective measures**

1) Thread release timing is not adequate

- A. If the timing of the thread release is too slow and the unreleased threads are trimmed off, either needle or bobbin thread may be broken.
- B. Adjust the thread release timing by means of the tension release lever according to the following chart (See also Fig. 30).

	Needle thread	Tension release lever
1	Too long	Turn it up.
2	Not uniform	Turn it up.
3	Short and jumps.	Turn it down.
4	Accidentally cut or jumps.	Turn it down.

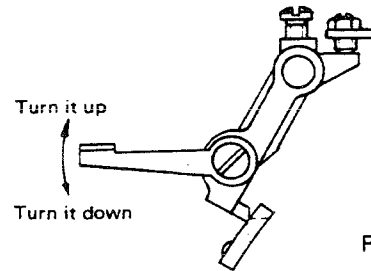


Fig. 30

2) Scratched moving knife

If the thread paths (A, B, C, D and E) on the moving knife are scratched, they may break the needle. Remove such scratches by applying abrasives. (Fig. 31)

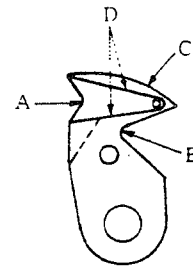


Fig. 31

3) Height of the counter knife

If the counter knife position is too high, the thread may touch it and break before the moving knife arrives in the cutting position. Correct the counter knife height by referring to the standard adjustment.

4) Scratched shuttle race spring

If surface A is scratched, it will cut the thread. Remove such scratches by applying some abrasives. (Fig. 32)

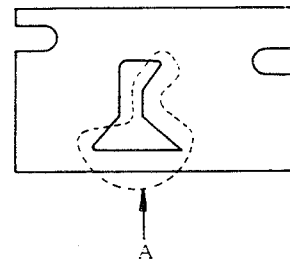


Fig. 32

5) The bottom surface of the needle plate needle hole guide is not smooth.

The threads drawn in by the moving knife for trimming will be cut by the rough surface of the guide. (Fig. 33)

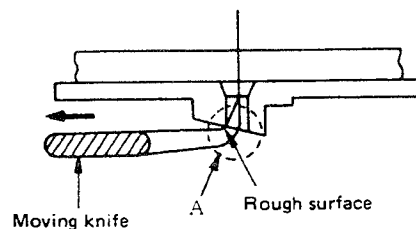


Fig. 33

6) Position of the moving knife

If the needle thread is too tight when it passes through the shuttle to form the last stitch, slightly increase the standard distance of 1.5 mm (1/16") between the thread hooking point of the moving knife and the nearest end of the needle hole in the needle plate. (See Fig. 10)

### (3) Thread trimming failure

Phenomenon . . . . . Even after a seam has been completed, either or both the needle and bobbin thread are not trimmed off or an excessively long or short needle thread is left in the needle eye after trimming.

- Possible causes . . . . .
- Thread trimmer knife is not sharp enough.
  - Moving knife is too far from the needle plate needle hole guide.
  - Moving knife is not properly adjusted.
  - Position of the shuttle race spring is not correct.
  - The last stitch is skipped.

#### Corrective measures

##### 1) Thread trimmer knife is not sharp enough.

A. If either the moving or counter knife blade is worn out after a long period of use or if a newly installed moving knife does not reach the cutting point over the counter knife, the thread trimmer knife will fail to cut sharply.

Usually, the sharpness of the blade will increase after it has been used for a while.

##### B. The correct position of each thread trimmer component

a. Height of the counter knife (Fig. 34-a)

b. Difference in height between the counter knife and the needle plate needle hole guide.

The counter knife must be 0.1 to 0.15 mm higher than the needle plate needle hole guide (Fig. 34-b).

c. Difference in height between the moving knife and the needle plate needle hole guide.

The lowest point of the moving knife is 0.15 mm lower than the highest point of the needle plate needle hole guide (Fig. 34-b).

This adjustment can be made by inserting a washer of suitable thickness.

Part No.	Description	Thickness
B2423-280-00A	Washer (for moving knife)	0.4 mm
B2423-280-00B	Washer (for moving knife)	0.5 mm
B2423-280-00C	Washer (for moving knife)	0.6 mm
B2423-280-00D	Washer (for moving knife)	0.7 mm

d. The moving knife shakes up and down too much.

Normally, the moving knife shakes from 0.05 to 0.1 mm at its top end.

C. If the right thread is not trimmed;

Adjust the counter knife by slightly lowering its top end.  
(See Fig. 34-a; lessen the difference of 0.2 mm.)

D. If the left thread is not trimmed:

Adjust the counter knife by slightly raising its top end.

(Note) Gently bend the counter knife for the above C and D adjustment taking care not to break it. (Fig. 34-c)

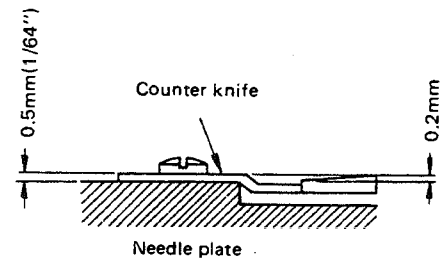


Fig. 34-a

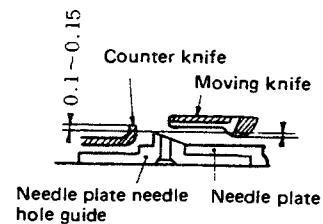


Fig. 34-b

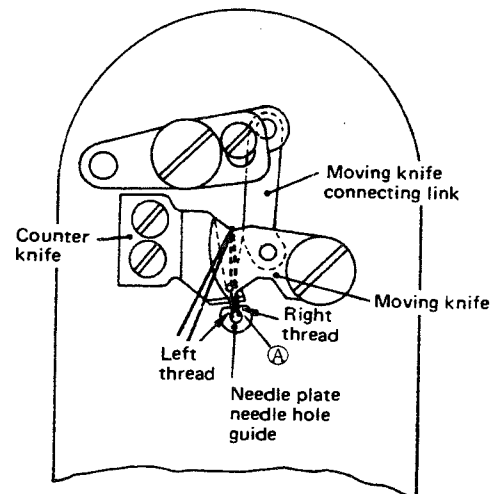




Fig. 34-c

- 2) If cut thread pieces are found in the cylinder arm cap;  
Remove burrs from the relevant part of the thread trimmer components as shown in Fig. 35. The cause of trouble can be detected by examining the shape of the cut thread pieces as shown below. As long as the threads are normally trimmed, the cylinder arm cap will not gather the cut thread pieces.

Shape of cut thread	Thread is cut by :
	Point B of the moving knife
	Point C of the shuttle race spring

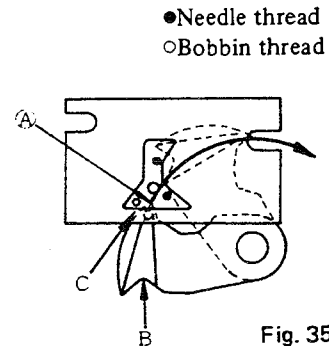


Fig. 35

- 3) The moving knife is not properly adjusted.
- A. If the moving knife is not properly adjusted, it may fail to hook the threads, or it may hook the needle thread twice or cause a similar failure.
- B. With a properly adjusted moving knife, the trajectory shown by thread hooking point A passes the inside of the needle hole as shown in Fig. 35.
- 4) Position of the shuttle race spring is not correct.  
Similar types of trouble to 3) may occur when the position of the shuttle race spring is not correct. Adjust the spring position by referring to Fig. 9.
- 5) The last stitch is skipped.  
If the last stitch is skipped, the trimmer knife will not hook the needle thread. Adjust the timing of the shuttle to the needle. (see Fig. 1)

#### (4) Needle breakage

- Phenomenon . . . . . Needle is broken when stitching.
- Possible causes . . . . .
- Shuttle driver does not protect the needle.
  - Feed timing is not correct.
  - Needle plate needle hole guide is scratched.
  - Needle hits the work clamp foot.
  - Moving knife is wrongly installed.

#### Corrective measures

- 1) The shuttle driver does not protect the needle.  
If the needle is not protected by the front end of the shuttle driver as shown in Fig. 1-d, it will touch the rotating shuttle while it is being warped to stick in the material and may break. Adjust the shuttle driver to give the correct needle position.
- 2) Feed timing is not correct.  
If the cloth feed action is not completed before the needle comes down to stick the material, the needle will be forced to bend and may be broken. Adjust the feed cam according to (1)-1)-E and Fig. 18. In general, the feed action must be completed by the time the needle has come down to 7 to 10 mm (9/32" to 25/64") above the needle plate surface.
- 3) Needle plate needle hole guide is scratched.  
The needle plate needle hole guide may be scratched by a broken needle or a needle being momentarily warped by the material while stitching. Remove such scratches from the surface of the guide, otherwise they will interfere with the needle's smooth motion resulting in needle breakage. The surface of the guide is harder than the needle, so that it cannot easily be scratched by the needle. However, if the guide is critically damaged, replace it with a new guide. Select a suitable needle plate needle hole guide for the needle size and the material by referring to the table in I-(18).
- 4) Needle hits the work clamp foot.  
Carefully adjust the position of the work clamp foot especially when the sewing size is changed, so that it doesn't touch the needle.
- 5) Moving knife is wrongly installed.  
When reassembling the trimmer knife components, do not forget to attach the moving knife connecting link. Otherwise, the needle will hit the moving knife and the both parts may be broken.

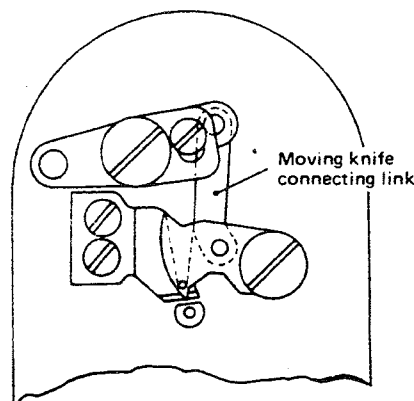


Fig. 36

## (5) Precautions when sewing synthetic materials

When synthetic or blend materials are sewn with synthetic threads, special attention should be paid to the following points;

### 1) Protection of the thread against overheating

If the thread or the material is melted by a needle heated by the frictional heat produced between the needle and the material, take the following preventive measures;

A. Replace the motor pulley with either B7101-280-00C (50 Hz) or B7102-280-00C (60 Hz) designed for synthetic material applications at a sewing speed of 1,700 s.p.m.

B. Use the silicon oil lubricator.

C. Use a needle for synthetic materials.

D. Use a finer needle to reduce friction.

### 2) Thread becomes fluffy

If the thread becomes fluffy when stitching, move the frame thread guide (A) to the left and increase the stroke of the thread take-up lever.

### 3) Starting stitches are loose.

If loose stitches are formed at the start of sewing, adjust the timing of the cloth feed. Follow the method of standard adjustment mentioned in I-(1) and adjust the feed cam so that the cloth feed action is completed when the pointed end of the needle is still in position within the specified adjusting range and closer to 10 mm ( $25/64''$ ).

### 4) The blades of the shuttle driver are scratched.

Synthetic threads tend to scratch the thread path surface when it is released. Remove such scratches by buffing the surfaces.

### 5) Smoothness of the thread paths

All the thread paths on the following components must be smooth enough to allow the thread to pass without friction;

Shuttle driver	B1813-980-000
Shuttle	B1818-280-000
Shuttle race spring	B1815-980-000
Needle plate needle hole guide	B2426-280-000
Needle bar thread guide	B1405-280-000

(Note) Without exception, use a DP x 5 needle. Do not use LQ x 5 which has been used with the conventional LK-232 model, because this needle may scratch the periphery of the needle hole in the needle plate, which may cause thread breakage.

## (6) Loose stitching

### (1) Firm stitching is not formed.

#### 1) Adjustment of the feed timing

To obtain tight stitches, adjust the feed cam according to the instructions given in I-(1) so that the cloth feed action is completed by the time the pointed end of the needle comes down to near 7 mm ( $9/32''$ ) in height.

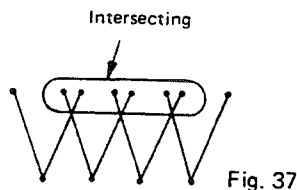
#### 2) Adjustment of tension controller No. 2 and the thread take-up spring

Increase the tensions of both components.

### (2) Overlapping stitching

#### 1) Adjustment of the direction of the needle

Rotate the needle by 5 to 10° to the left from the standard direction. Do not rotate it too much, or stitches may be skipped. (Fig. 37)



### III. THINGS TO BE NOTED WHEN DISASSEMBLING AND ASSEMBLING THE MACHINE

#### (1) How to remove the shuttle driver shaft

When removing the shaft do not pull out the pin from the drive gear attached to the shuttle driver shaft under any circumstances, or the needle bearings under the rear sleeve will break.

To remove the shuttle driver shaft, loosen the setscrews of the shuttle driver and the thrust washer and screw of the oscillating rock shaft located under the bed, and the shaft can be pulled out from the rear of the machine.

#### (2) How to remove the main shaft

- 1) Take out the needle.
- 2) Remove the stop-motion lever.
- 3) Set the feed cam driving worm free by loosening the setscrews and remove each setscrew of the counterweight, thrust collar and main shaft rear bushing. Do not forget to remove the screws from the main shaft rear bushing, because these screws have been screwed into the countersunk part of the bushing as shown in Fig. 38.
- 4) Remove the tension spring from the knife driving bar and keep the knife driving rod tripping assembly away from the rear end of the main shaft rear bushing.
- 5) Press a brass rod against face  $\text{\textcircled{A}}$  and tap it so that the main shaft comes out (Fig. 38).

### IV. ELIMINATION OF EXCESSIVE PLAY

#### (1) Excessive play in the main shaft

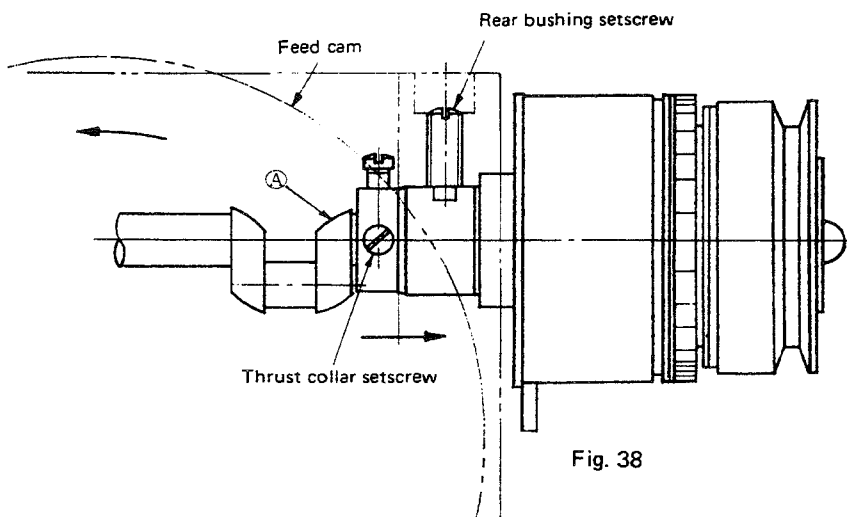


Fig. 38

- 1) When the main shaft becomes loose in its axial direction after a long period of operation, it will affect the timing of the feed and thread tension release actions. To eliminate this, move the thrust collar in the direction of the arrow while rotating the feed cam in the same direction (Fig. 38).
- 2) Provide the main shaft with a normal play of 0.01 to 0.04 mm.
- 3) After this adjustment, the timing of the feed cam, stop-motion regulating cam and thread tension release action must be readjusted accordingly.

#### (2) Excessive play of the feed cam driving worm against the feed cam driving worm wheel

- 1) This play will affect the timing of cloth feed.
- 2) Remove the cover from the machine arm and loosen the 4 screws which set the feed cam driving worm. Firmly hold the worm wheel shaft to keep it in position in relation to the main shaft and turn the worm in the direction of the arrow, so that the worm moves towards the main shaft rear bushing and the excessive play is eliminated. After this adjustment, securely tighten the 4 screws (Fig. 39).

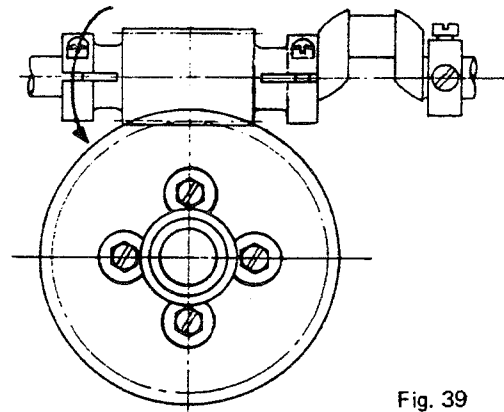


Fig. 39



### (3) Excessive play of the feed cam roller

Eliminate excessive play from the feed cam roller by using a suitable roller.

The roller's outer diameter is 11 mm (7/16") for models LK-980, 982, 983 and 984:

B2502-280-B0A	Feed cam roller $\phi$ 11	+0.010 +0.005
B2502-280-B0B	Feed cam roller $\phi$ 11	+0.005 0
B2502-280-B0C	Feed cam roller $\phi$ 11	0 -0.005

The roller's outer diameter is 9.5 mm (3/8") for models LK-985 to LK-992 :

B2502-280-00A	Feed cam roller $\phi$ 9.5	+0.010 +0.005
B2502-280-00B	Feed cam roller $\phi$ 9.5	+0.005 0
B2502-280-00C	Feed cam roller $\phi$ 9.5	0 -0.005

### (4) Excessive play in the shuttle driver shaft

Use a suitable shuttle driver shaft with crank :

B1806-980-0AA	Shuttle driver shaft with crank	Standard
B1806-980-0AB	Shuttle driver shaft with crank	0.1 mm larger in diameter

### (5) Cork linings in the clutch components

There are 3 cork linings in the clutch unit. The brake cork ring and the low speed cork ring are designed to self-align as they wear. However, the driving clutch (B1235-980-000) must be adjusted when its cork lining has worn, or it may slip and cause loss of speed. In this case, adjust the driving pulley pressing plate as per the standard adjustment instructions (6).

Readjust or replace the clutch components with cork linings in the following cases (See "2. Main Shaft Components" in the Parts Book):

#### 1) Brake cork ring (B1234-980-000)

If the brake cork ring slips while operating at low speed make sure that it is not caused by oil leaking into the mechanism and then replace the stop ring (intermediate) (B1230-980-000) with a thinner one as mentioned below;

B1230-980-00A	0.8 mm thick	Stop ring (intermediate)
---------------	--------------	--------------------------

If, even after having replaced the stop ring, slipping continues to occur, replace the brake cork ring itself.

(Note) When replacing the stop ring, do not apply too much grease. To replace the brake cork ring, disassemble the brake components, take out the outer ring of the ball bearing on the brake and insert a new brake cork ring by tapping gently. Take care to insert it correctly.

#### 2) Driving clutch (B1235-980-000)

If the driving clutch slips while operating at high speed even after the driving pulley pressing plate has been adjusted according to the standard adjustment, replace the main shaft thrust washer (C) with a thicker washer as mentioned below;

B1221-771-00E	1.6 mm (1/16") thick	Main shaft thrust washer
---------------	----------------------	--------------------------

#### 3) Low speed cork ring (B1247-980-000)

Replace the low speed cork ring with a new one as soon as clearance (A) shown in the Structural Drawing of the Clutch Components (p. 26) has decreased to 2.2 mm (3/32") or less at high speed.

If the low speed cork ring is worn out, the start pedal will not operate smoothly. Adjust it according to standard adjustment (6).

(Note) When you replace the low speed cork ring, install it using a new C ring (RC-1381001-KP) which is stored in the accessory box.

## V. DETAILS OF ADJUSTMENT

### (1) Adjustment for starting & stopping (Clutch and Stop-motion mechanism)

#### (1) Method of adjustment

1) When the machine will not run at a high speed ;

A. Mechanical friction is too great.

If excessive friction is produced by tight engagement of the worm gears or other parts, the important parts in the machine including the cork linings will be heated up and worn out. Guard against excessive friction.

B. The driving pulley pressing plate does not work properly.

In this case, the driving pulley will slip and will not drive the machine at a high speed. Adjust it according to standard adjustment (6).

C. The stop-motion connecting pin is not properly adjusted.

The machine will not run at a low speed, if the idling period of the brake cork ring is longer than that of the standard period stipulated in standard adjustment (7).

D. If stop-motion ball ①, shown in the Structural Drawing of the Clutch Component (p. 26), accidentally comes away from the main shaft, the clutch surface can not be aligned properly. Therefore, prevent the ball from falling by applying grease to the main shaft beforehand.

2) When the machine fails to start :

A. If the starting lever stopper is not properly positioned, the machine may not start or may start to run at high speed immediately after the pedal is depressed. Adjust the starting lever stopper so that it is actuated when there is a 1 mm (3/16") clearance, between the stop-motion regulating cam and the stop-motion regulating cam roller (Fig. 40) when operating at low speed.

B. If unusual load is produced in the machine, it may suddenly stop when changing running speed from low to high. Adjust the machine by removing the cause of such a mechanical load.

3) When the machine will not run at low speed :

A. If it is due to excessive friction produced by the machine mechanism, remove the cause.

B. If oil or grease on the cork surface causes the cork rings to slip, clean the cork surface with alcohol (do not use thinner or trichlene, as these may damage the cork).

C. Check to see if the driving pulley pressing plate is correctly positioned according to standard adjustment (6).

4) When unusual sound is produced;

A. If unusual sound is produced only at the time of low speed operation before or after starting or stopping, it means that the stop-motion ball has been scratched due to inadequate adjustment, as mentioned in standard adjustment (7).

If critically damaged, the ball must be replaced.

B. Concerning standard adjustment (3), if white line No. 2 on the stop-motion hook enters too far into the periphery of the brake ring, the hook will hit the stop-motion regulating cam and make a click.

C. If edge ② of the driving plate is worn out, the thread trimming cam will hit the cam roller intermittently producing a click and shaking the thread trimmer. Adjust as per standard adjustment (3). If edge ③ of the driving plate has been critically deformed, replace the driving plate (Part No. B2624-980-000).

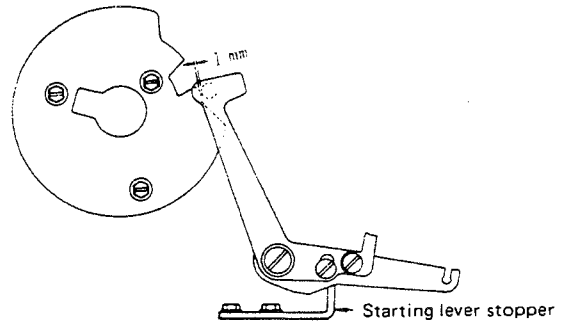


Fig. 40

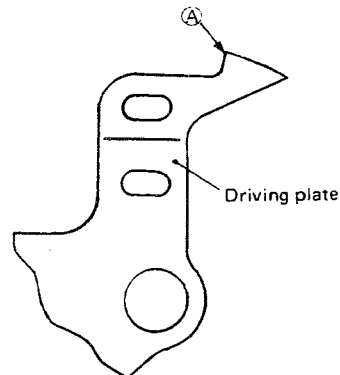


Fig. 41

D. If the cork surface on the clutch ring is not even, it will not grip properly and may make a scraping sound at the time of starting and stopping.

If made when starting, the sound is caused by contact between driving clutch ② and low speed cork ring ③ as shown in the Structural Drawing of the Clutch Components, page 26.

A sound at the time of stopping will be made by brake cork ring ④ shown in the same drawing.

Remove the cork material which causes the sound and correct its shape with sandpaper so that the contact surface is smooth and even.

E. If the drive belt tension is too high, and the stop-motion regulating cam does not conform to standard adjustments (4) and (5), or if the tension of the main shaft spring is too low, the timing of the clutch release at low speed will become too slow and the shock caused by the stop-motion will be increased. An excessive shock will strain the machine and will cause the wiper to hit the needle point.

F. Do not let the pressing plate press the driving pulley too much, because it rotates the driving pulley while the machine is in "stop-motion," the driving pulley rotates the low speed cork ring and the brake cork ring together and they overheat the ball bearings and make a noise.

As the result of this, the clutch spring ( ④ , p. 25), and the clutch brackets ( ③ and ( ⑤ p. 25), may wear away.

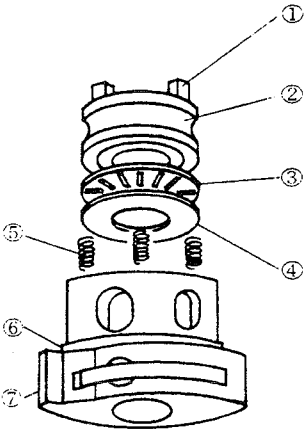
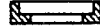
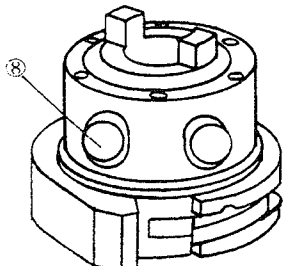
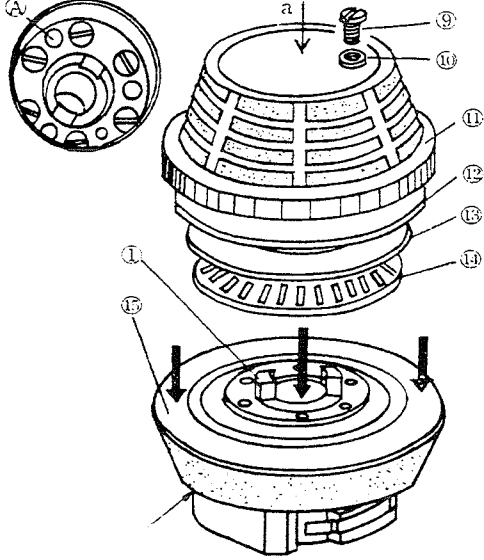

G. Make sure that the C rings and washers securely hold the cork rings in place. If not, the same troubles as mentioned in paragraph F may be caused to rapidly wear the clutch spring and the clutch brackets.

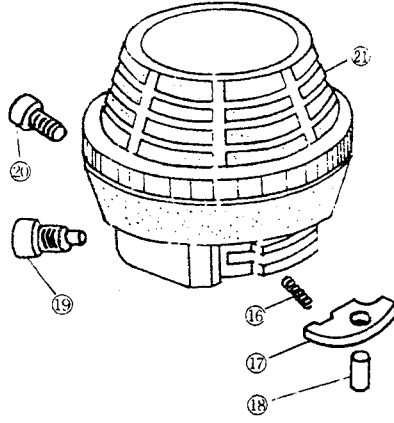
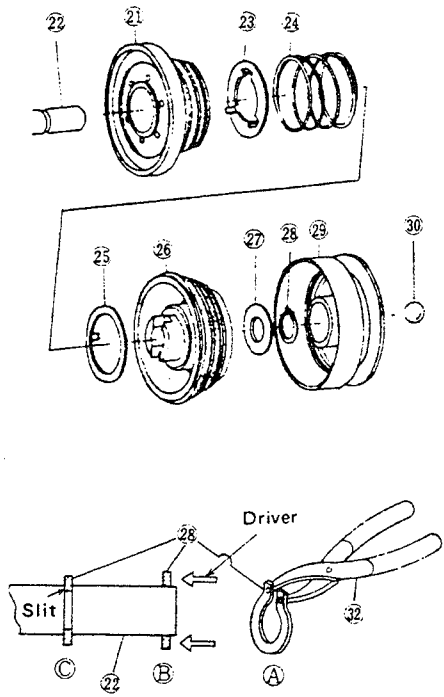
#### 5) Overheating

Frictional heat will build up in the cork material if the machine is continuously started and stopped.

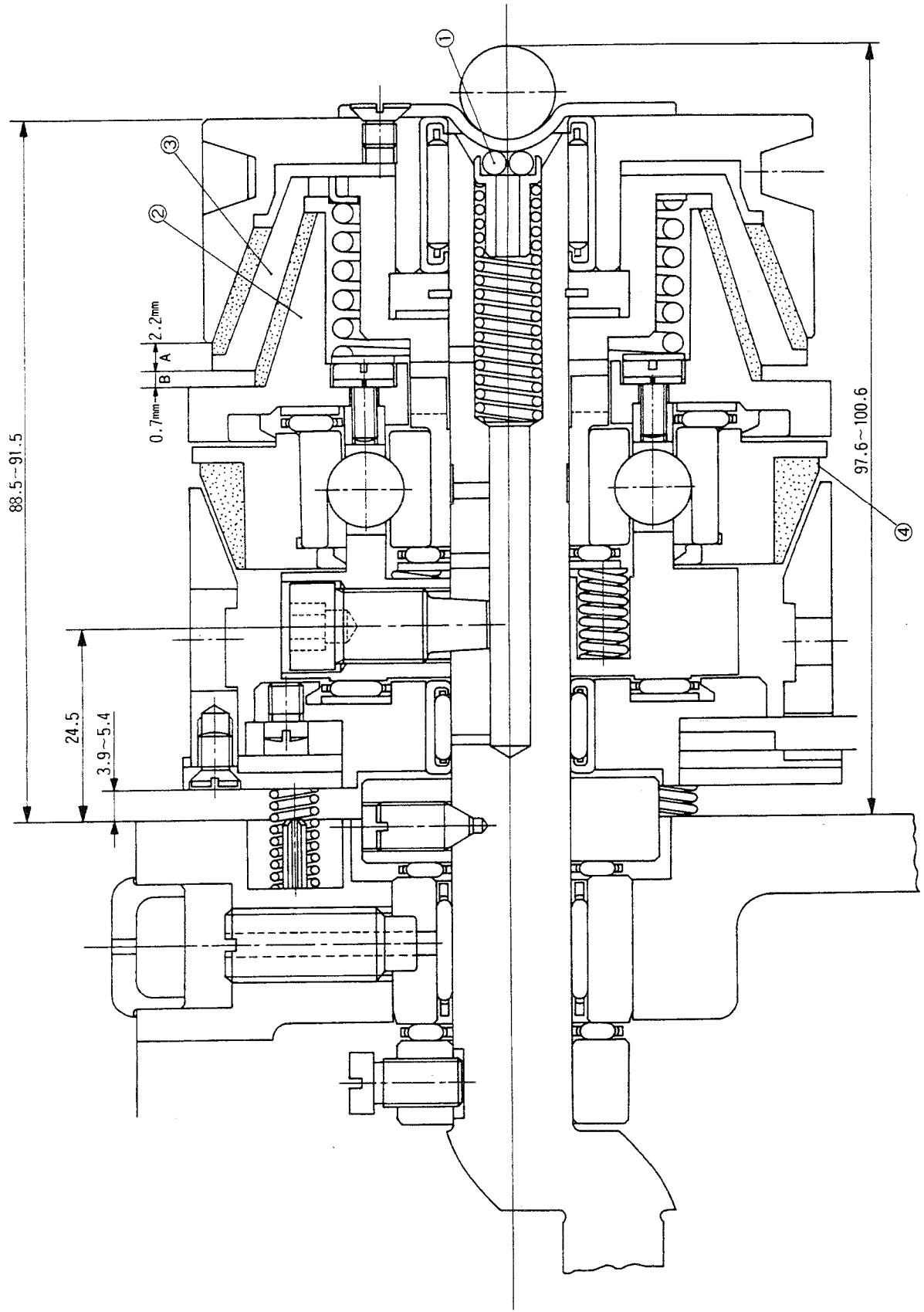
When the machine runs with a heavy torque which is accidentally produced by some mechanical fault, it will stop running at low speed allowing the motor to keep rotating and the clutch to keep slipping. This failure may overheat the cork material. In such a case, turn off the main switch and locate & adjust the cause of the mechanical trouble.

(2) How to assemble the clutch components

Assembling order	Remarks	Things to be noted when disassembling the clutch components
 <p>① Pawl ② Bushing ③ Main shaft thrust bearing ④ Thrust washer (small) ⑤ Ball pushing spring ⑥ Grease seal (small) ⑦ Stop-motion cam</p>	<ol style="list-style-type: none"> <li>1) Insert grease seal (small) ⑥ into stop-motion cam ⑦ with the wider end of the seal up (  ).</li> <li>2) Apply grease to the surfaces of ball pushing springs ⑤, thrust washer (small) ④ and mainshaft thrust bearing ③, lower end surface and contact surface with balls of bushing ② and inside faces of pawls of bushing ②.</li> <li>3) Take care not to make a mistake in the assembly order of ④ and ③.</li> <li>4) Align each part ①, ③ and ④ concentrically. (Note) When replacing the ball bearing, pawls ① must be pulled out and inserted again. When replacing bushing ②, make sure that pawls ① are entirely inserted into ② so that their bottom surfaces are flush with each other.</li> </ol>	
 <p>⑧ Ball</p>	<ol style="list-style-type: none"> <li>1) Fill one half of each of 6 oval openings in stop-motion cam ⑦ with grease.</li> <li>2) Insert each ball ⑧ into its opening. (Note) Take care to keep the balls and the mating surface clean. Dust or foreign bodies on the surfaces will cause noise.</li> </ol>	
 <p>⑨ Screw ⑩ Spring washer ⑪ Driving clutch ⑫ Grease seal (large) ⑬ Stop ring (large) ⑭ Thrust needle (large) ⑮ Ball bearing</p>	<ol style="list-style-type: none"> <li>1) Apply grease to the outer surface of the ball bearing cage, i.e. the surfaces between stop ring ⑬ thrust needle ⑭ and point A of the driving clutch.</li> <li>2) Make sure that the wide-open end of seal ⑫ faces upwards (  ).</li> <li>3) Affix stop ring ⑬ to the bottom surface of driving clutch ⑪.</li> <li>4) Insert ball bearing ⑮ in the direction of the arrow while pressing pawls ① against the ball bearing.</li> <li>5) Fix ⑪, ⑬ and ⑭ together by tightening screws ⑨ with spring washers ⑩.</li> <li>6) Introduce grease seal (small) ⑥ into gap B in the ball bearing ⑮.</li> <li>7) Make sure the order of assembling ⑬ and ⑭ is correct.</li> </ol>	<ol style="list-style-type: none"> <li>1) To disassemble the unit press pawls ① from above and pull out ball bearing ⑮.</li> <li>2) Take care not to drop the balls.</li> </ol>

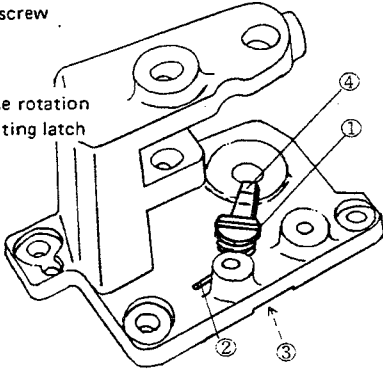
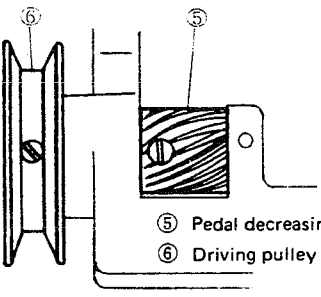
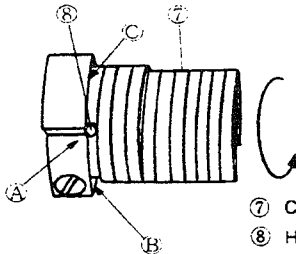
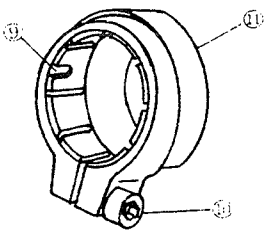
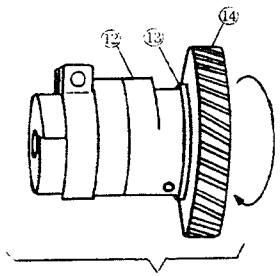
Assembling order	Remarks	Things to be noted when disassembling the clutch components
 <p> <b>16</b> Safety plate stopper spring  <b>17</b> Stop-motion cam latch  <b>18</b> Pin  <b>19</b> Screw  <b>20</b> Screw </p>	<ol style="list-style-type: none"> <li>1) Insert safety plate stopper spring <b>16</b> and install stop-motion cam latch <b>17</b> and pin <b>18</b> in position.</li> <li>2) Make sure the order of inserting screws <b>19</b> and <b>20</b> is correct. (Note) Do not apply grease or oil to the cork surface.</li> <li>3) Set assembled clutch <b>21</b> on to main shaft <b>22</b> and firmly tighten screw <b>19</b> and <b>20</b>.</li> </ol>	
	<ol style="list-style-type: none"> <li>1) Apply grease evenly to the inner end faces of <b>23</b>, <b>24</b>, <b>25</b> and <b>26</b> and insert them in the order as illustrated.</li> <li>2) Let the projection on clutch bracket <b>25</b> rest in the recess of cork ring <b>26</b> and insert them into shaft <b>22</b>.</li> <li>3) Apply grease evenly to the end face of <b>27</b> and fix it together with <b>26</b> using C ring <b>28</b>.</li> <li>4) When inserting C ring <b>28</b>, take care not to open it too much. Otherwise the ring will come off during operation. Do it in the following way; <ol style="list-style-type: none"> <li>(4.1) Slightly open C ring using tool <b>32</b> and insert it to position <b>B</b> from <b>A</b>.</li> <li>(4.2) Gently push it to position <b>B</b> from <b>C</b> using two screw drivers.</li> <li>(4.3) Ensure that C ring <b>28</b> rests in the groove on <b>27</b> using your fingers.</li> </ol> </li> <li>5) Install <b>29</b> and <b>30</b> in the order as illustrated.</li> </ol>	<ol style="list-style-type: none"> <li>1) Always use a new C ring (RC-1381001-KP) which is stored in the accessory box. Do not use the old ones.</li> <li>2) Use a special tool <b>32</b> (J1064000000) when you set a C ring <b>28</b>.</li> </ol>

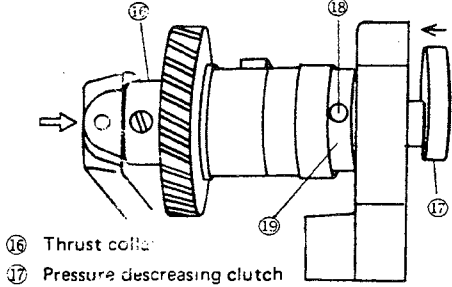
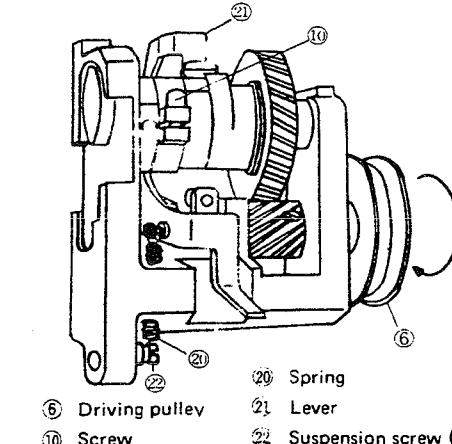
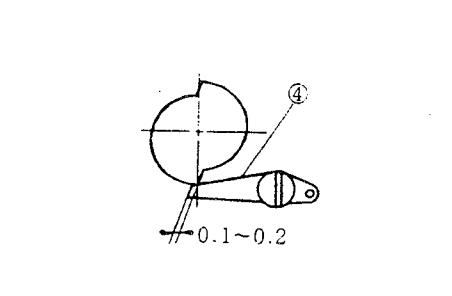
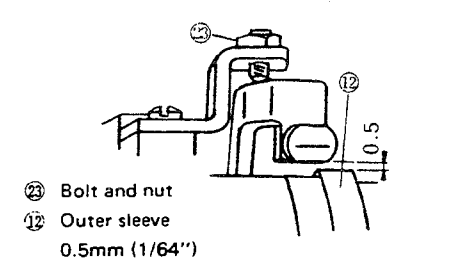
STRUCTURAL DRAWING OF THE CLUTCH COMPONENTS



## (2) Adjustment of the pedal pressure decreasing unit

### (1) How to assemble the unit

Assembling order	Remarks	Things to be noted when disassembling the unit
 <p>① Hinge screw ② Spring ③ Nut ④ Reverse rotation preventing latch</p>	<p>1) Attach hinge screw ①, spring ② and reverse rotation preventing latch ④ to the pedal pressure decreasing unit frame.</p>	
 <p>⑤ Pedal decreasing gear (small) ⑥ Driving pulley</p>	<p>1) Install driving pulley ⑥ and gear ⑤ not allowing any play in the axial direction.</p>	
 <p>⑦ Clutch spring (B) ⑧ Hole</p>	<p>1) Insert clutch spring ⑦ by turning it in the direction of the arrow until there is no gap at point A, but do not turn it too much. 2) Apply grease both to the inside and outside faces of the spring.</p>	<p>1) To remove the spring, carefully insert the blade of a screw driver into gap C and gently push it out. Do not pull it out roughly, or the spring will stretch and deform.</p>
 <p>⑨ Recession ⑩ Screw ⑪ Outer sleeve</p>	<p>1) Align hole ⑧ with recession ⑨ in the inner sleeves. 2) Temporarily fix outer sleeve ⑪ to the inner sleeve by pressing it against face B and tightening screw ⑩.</p>	
 <p>⑫ Outer sleeve ⑬ Pulley ring ⑭ Pressure decreasing gear (large)</p>	<p>1) Press the top end of the spring against the pin of outer sleeve ⑫ and insert the outer sleeve. 2) Apply grease to the inner surface and both sides of pulley ring ⑬. 3) Apply grease to the inner and outer surfaces of the shaft of gear ⑭ and insert the gear by turning it in the direction of the arrow.</p>	<p>1) To remove the gear, turn it in the direction shown by the arrow.</p>

Assembling order	Remarks	Things to be noted when disassembling the unit									
 <p>⑬ Thrust collar ⑭ Pressure decreasing clutch</p>	<ol style="list-style-type: none"> <li>1) Attach gear assembly ⑮ and thrust collar ⑬ and insert clutch ⑭ while pressing latch ④ against them.</li> <li>2) After making sure that hole ⑮ tapered hole on clutch ⑭ and tapered hole ⑯ are correctly positioned insert the cotter pins.</li> </ol>	<ol style="list-style-type: none"> <li>1) Loosen screw ⑩ remove cotter pin ⑮ and then tap the unit at the point shown by arrow (⇒).</li> </ol>									
 <p>⑥ Driving pulley ⑩ Screw ⑳ Spring ㉑ Lever ㉒ Suspension screw (B)</p>	<ol style="list-style-type: none"> <li>1) Hang spring ㉑ on the cover and attach lever ㉑.</li> <li>2) Anchor spring ㉑ to suspension spring ㉒.</li> </ol>										
<p>See above figure.</p>	<ol style="list-style-type: none"> <li>1) Turn driving pulley ⑥ in the direction of the arrow until clutch ⑭ is disengaged and then firmly tighten screw ⑩ in the illustrated position.</li> </ol> <p>Since this screw tends to become loose during operation, tighten it carefully.</p>										
 <p>④ Reverse rotation preventing latch</p>	<p>(Note) When replacing the clutch spring, make sure that there is a clearance of 0.1 to 0.2 mm at the tip of latch ④ when clutch ⑭ stops rotating as you turn driving pulley ⑥ in the direction of the arrow.</p> <p>If this clearance is too great or too small, select a suitable replacement part from the ones listed below:</p> <table border="0"> <tr> <td>B3009-980-00A</td> <td>Clutch spring</td> <td>Short</td> </tr> <tr> <td>B3009-980-00B</td> <td>"</td> <td>Medium</td> </tr> <tr> <td>B3009-980-00C</td> <td>"</td> <td>Long</td> </tr> </table>	B3009-980-00A	Clutch spring	Short	B3009-980-00B	"	Medium	B3009-980-00C	"	Long	
B3009-980-00A	Clutch spring	Short									
B3009-980-00B	"	Medium									
B3009-980-00C	"	Long									
 <p>㉓ Bolt and nut ⑫ Outer sleeve 0.5mm (1/64")</p>	<ol style="list-style-type: none"> <li>1) Adjust bolt and nut ㉓ so that there is a clearance of 0.5 mm (1/64") between the hooked end of the pressure decreasing lever and the pawl of outer sleeve ⑫ when the lever is pushed down by turning driving pulley ⑥.</li> </ol>										



## (2) Things to be checked after adjustment

- 1) Turn outer sleeve ⑩ 2 mm (5/64") in the reverse direction and release it. The outer sleeve shall return easily. If there is any friction, clutch spring ⑦ will not drive the unit. If it shakes while rotating, sounds will be produced in the gears. Correct the end face of thrust collar ⑥ or replace it with a suitable replacement part;  
B3016-980-00A Thrust collar for sleeve, 11.6 mm thick  
B3016-980-00B Thrust collar for sleeve, 11.75 mm thick
- 2) Turn driving pulley ⑥ in the direction of the arrow until the shaft stops and check that the top end of reverse rotation preventing latch ④ is 0.1 to 0.2 mm away from the front face of the pawl of outer sleeve ⑩. If the clearance is greater than that, the latch will fail to engage with the pawl and will idle and shake when the motor is engaged. If the clearance is too small, clutch spring ⑦ will not actuate the unit. Replace the clutch spring with a suitable one from among the 3 different types of spring.
- 3) When sounds are produced;
  - A. If the gears make sounds;
    - a. Correct any excessive play in the axial direction in the gears (large and small).
    - b. Remove dust or foreign bodies from the gear teeth.
  - B. If a vibration noise is produced;

Check the clearance at the reverse rotation prevention latch according to 2) of (2) Things to be checked after adjustment.
- 4) Other failures

The following failures may occasionally occur;

  - A. The shaft of the gear (large) on the mating surface with the clutch spring has worn out. If its diameter becomes 19.2 mm (3/4") or less, renew the gear assembly.
  - B. The clutch spring is defective. If the inner diameter of the clutch spring has become 18.9 mm (3/4") or more, or if the spring is deformed, renew it.

## (3) Adjustment of the thread trimmer components

- 1) If the moving knife shakes with a click while the machine is running at low speed, remove the thread trimmer components except for the thread trimmer cam on the main shaft and insert the stop-motion cam assembly without tightening the setscrews. Insert bed hook (See page 1 "1. Frame and Miscellaneous Cover Components" in the Parts Book) into gap ④ between the stop-motion hook and the closest point of the stop-motion cam (at the point where the radius of the stop-motion cam is the largest) and ensure that there is a 0.7 to 0.8 mm (1/32") clearance between the thread trimmer cam and the cam roller (at point ③). If edge ② (B1109-280-000) of the driving plate is worn out, the cam roller will not be kept away from the thread trimmer cam surface. Replace the worn driving plate (B2624-980-000). If the clearance at ③ is too small, the trimmer knife will shake with a click during low speed operation. If the clearance is too much, the start pedal will become heavy. (Fig. 42)

- 2) If the trimmer knife does not move enough, check it in the following way;

Put the stop-motion hook into the stop-motion cam at point ⑤ as shown in Fig. 43 and let the cam roller rest in the recessed part of the thread trimmer cam (point ④). In this position, there must be a 0.5 mm (about 1/64") clearance at point ⑤.

If there is no clearance at point ⑤ and the cam roller does not come into contact with the thread trimmer cam at point ④, the moving knife will not trip sufficiently to hook the thread for cutting. If the clearance is too much, it will make the clearance at point ③ smaller during low speed operation and make the start pedal heavy.

- 3) Tension spring on the knife driving connecting link

If the tension spring is not installed or it does not produce correct tension in the knife driving bar (4.6 Kg when the entire length is 99 mm (3-57/64")), the moving knife will not operate correctly. Replace the tension spring (B2410-980-000) if it is found to be defective.

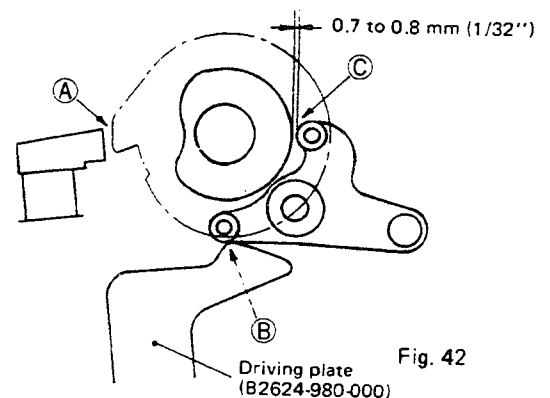


Fig. 42

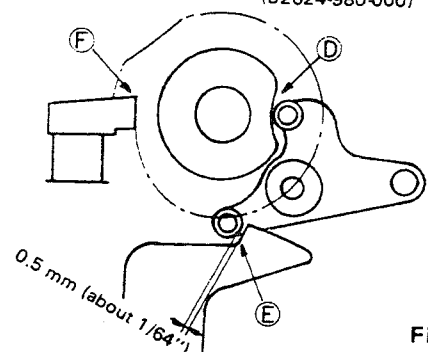


Fig. 43

4) Thread tension release component (Fig. 44)

If an adequate timing to release the thread is not provided by the tension release lever detailed in the standard adjustment (13), loosen screw ① and adjust tension release link ②.

This adjustment is effective provided that the top end of tension release pin ④ has reached the slanted surface of tension release bar ③ when the machine is in stop-motion (the stop-motion pawl goes up on top of the notch).

If the top end of the tension release pin is still on the flat surface of the tension release bar as shown by ⑤ in Fig. 44-b, tension release bar ③ will not be pulled back by the thread tension spring.

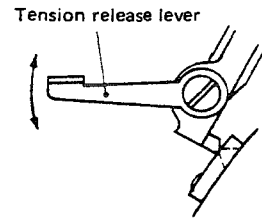


Fig. 44-a

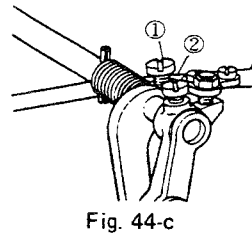


Fig. 44-c

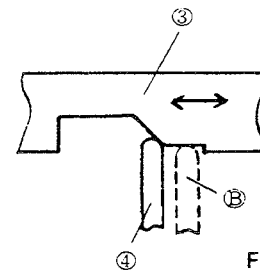


Fig. 44-b

(4) Feed cam components

(1) Adjusting the lengthwise feed pitch

1) Loosen the lock nut and adjust the feed regulator knob with a 14 mm (35/64") wrench. Turn the hexagonal stem of the regulator in the anticlockwise direction to increase the lengthwise feed pitch, and in the clockwise direction to decrease it. (Fig. 45)

2) After setting the feed pitch, firmly tighten the lock nut.

(2) Positioning the feed across driving arm connecting rod

The connecting rod should be positioned at a distance of 8 mm (5/16") from the nearest end of the driving arm as shown in Fig. 46, so that the crosswise feed pitch of the bar tack is adjusted by means of the feed across scale and the wing nut within the regular adjusting range. The adjusting range can to some extent be increased to either side beyond the regular limit, by increasing or decreasing the said distance of 8 mm (5/16"). (Fig. 46)

(3) Position of the work clamp foot and the feed plate

If the machine does not perform an expected cross feed after a stitch size is changed to the other, loosen the nut which fastens the feed cam roller shaft and adjust the setting position of the feed cam roller shaft by moving it in the oval hole in the feed across regulator; Raise it to move the work clamp foot and the feed plate to the right or lower it to move them to the left. (Fig. 46')

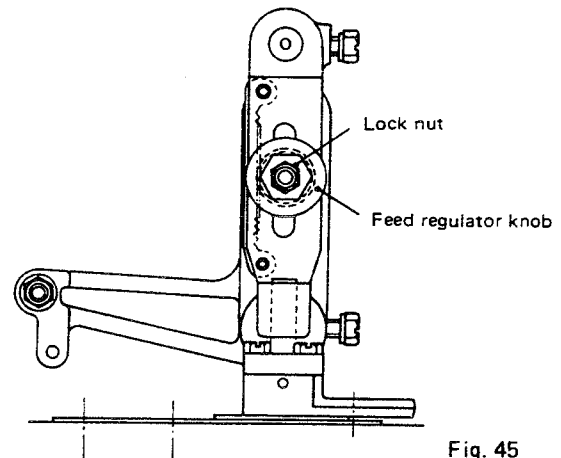


Fig. 45

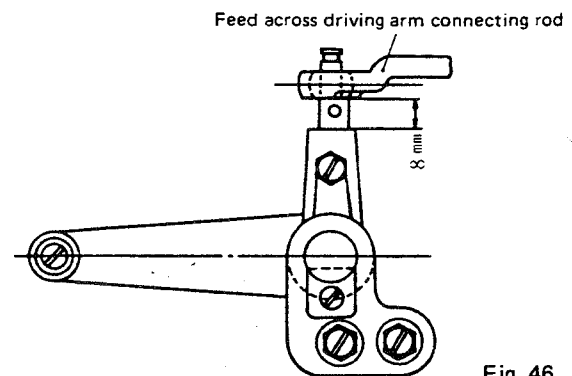
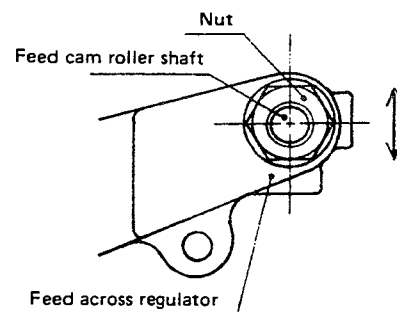


Fig. 46



(3) Adjusting the front and rear base-lines (Fig. 47)

- 1) Make sure that the needle passes the feed plate and work clamp foot evenly without touching them at any point.

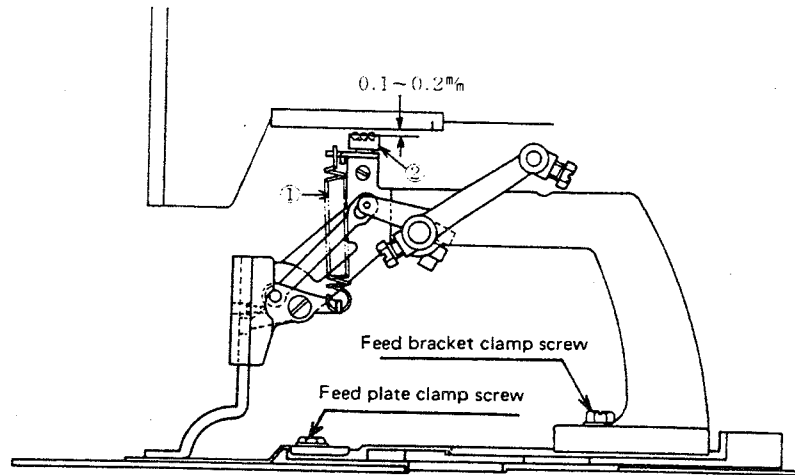


Fig. 47

- 2) Positions of the feed plate and the work clamp foot can be adjusted according to the front and rear base-lines of the bar tack by loosening the clamp screws of the feed plate and the feed bracket. Take care not to damage the aluminium feed plate when loosening or tightening the clamp screw.

(Note) Provide a 0.1 to 0.2 mm clearance between the top end of ball retainer ② and the bottom surface of the machine arm when springs ① are removed.

If there is no clearance, action of the work clamp foot will be hindered.

(5) Adjustment of the shuttle race

- 1) To adjust the shuttle race position in its axial direction, loosen the clamp screw and then turn the shuttle race adjusting shaft which is located on the right side face of the machine bed as shown in Fig. 48.
- 2) To take out the shuttle race, the shuttle race adjusting shaft must be removed from the bed. It is advisable to insert the shaft setscrew into the shaft and remove them together. Before taking out the shuttle race, remove the oil felt presser plate which is connected to the oil wick on the bottom of the machine bed.
- 3) In order to prevent the shuttle from seizing due to overheating, use a special shuttle for LK-980 Series models and apply a drop of lubricating oil to the raceway of the shuttle race and about 1/10 of oil in the attached oiler to the oil tank felt installed in the machine base.

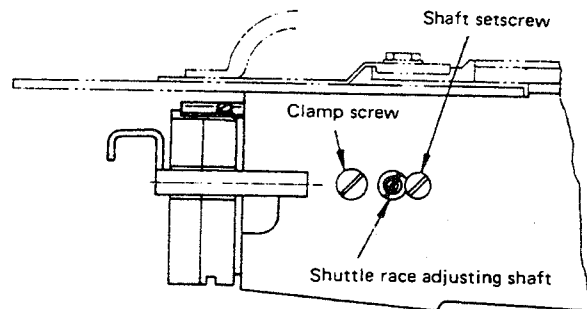


Fig. 48

### (6) Height of the work clamp foot

- 1) The height of the work clamp foot can be adjusted from 6 to 15 mm (15/64" to 19/32") according to the thickness of the material to be sewn.
- 2) Loosen the nut which clamps the work clamp foot lowering fork and adjust the height by rotating the stud (Fig. 49).
- 3) When adjusting the height of the work clamp foot, it is advisable to stop the machine with the foot up (this can be achieved by stopping the motor while the foot is being lifted by the pedal operation), so that the height is visible.

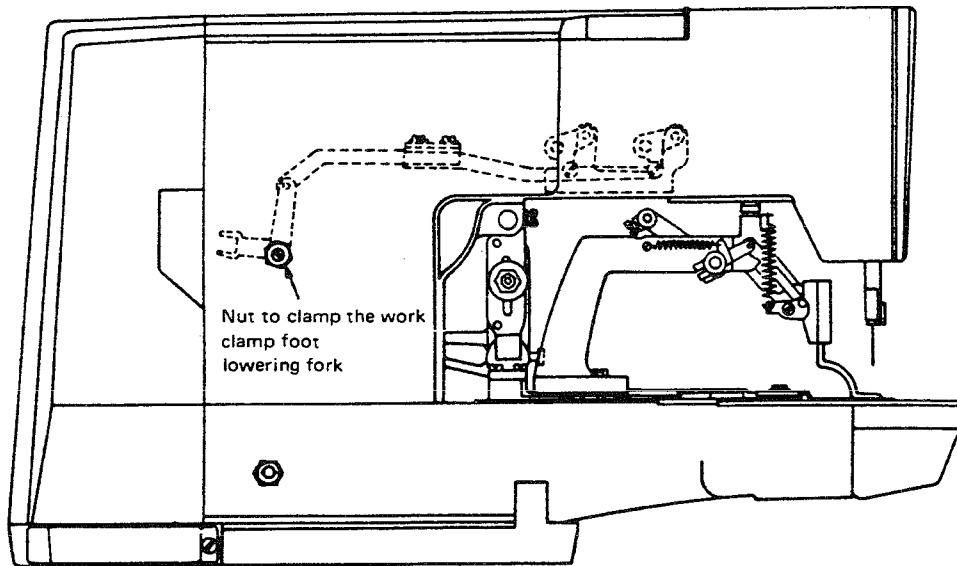


Fig. 49

### (7) Height of the wiper

Carefully adjust the height of the wiper so that it does not hit the work clamp foot, needle point, needle clamp screw, finger guard or other neighbouring parts. (Fig. 50)

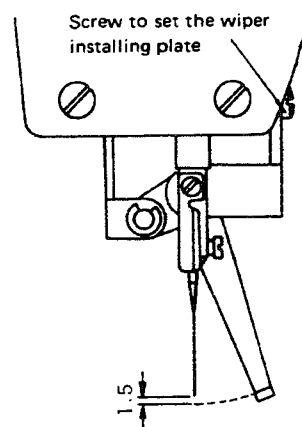


Fig. 50

### (8) Checking the safety device

#### (1) Safety plate

- 1) Turn the motor switch OFF while the work clamp foot is up.
- 2) Remove the upper end of tension spring **A** of the starting lever (this is not necessary if the machine has a 2-pedal system).
- 3) Depress the start pedal and ensure that the stop-motion hook trips in the range of 2.5 to 4 mm (3/32" to 5/32"). If it moves more than 6 mm (15/64"), renew the safety plate (B3030-980-000). (Fig. 51)

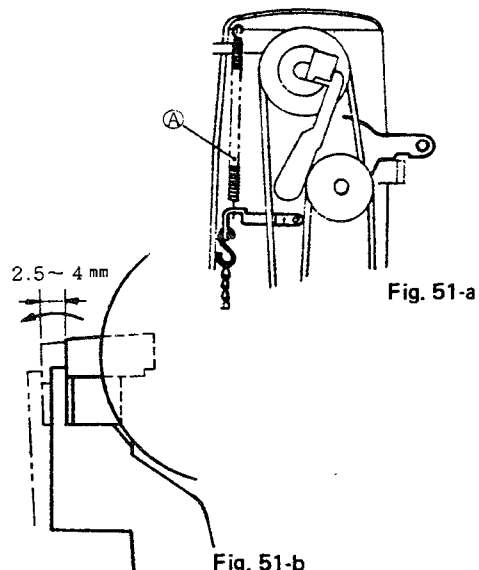


Fig. 51-a

Fig. 51-b

### (9) Adjustment of the bobbin winder

The bobbin should wind to about 80 percent of its full capacity. If the bobbin winder winds it more or less than 80 percent, correct it by means of the bobbin winder adjusting screw (Fig. 52).

(Note) In order to prevent any possible failure, use only JUKI bobbins specially designed for LK-980 Series.

B1828-280-0A0	Bobbin case
B1827-280-000	Bobbin

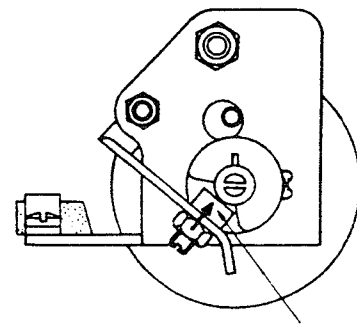


Fig. 52

Bobbin winder adjusting screw

### (10) Tension of the V-belt

Adjust the V-belt tension by changing the position of the slide-type motor base so that the V-belt is slackened 10 to 15 mm (25/64" to 19/32") at the middle point when pressed with the fingers (about 1 kg). The pressure decreasing belt is automatically controlled by the tension pulley. The tension produced by the tension pulley spring can be adjusted by 3 different anchors.

### (11) Silicon oil lubricator

If the lubricator is filled with the wrong oil by mistake, remove the cap from the machine arm cover by using the blade of a screw driver, take out the cylinder-shape silicon oil tank felt and squeeze the oil out of the naked part of the felt strip by using blotting paper or cloth. Never pull out the felt strip, because it cannot be inserted again.

### (12) Application of "lock-tight" paint

In order to prevent the screws from loosening during operation, "lock-tight" paint is applied to the under-mentioned parts. If these parts are disassembled, remove the residual paint by using thinner and dry them completely before reassembling. If it is very hard to disassemble the parts, heat them slightly with a blow-torch. "Lock-tight" paint is applied to the following parts.

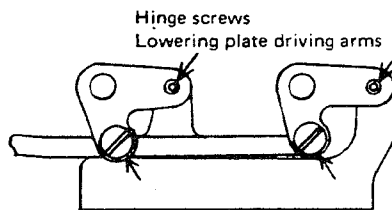


Fig. 53

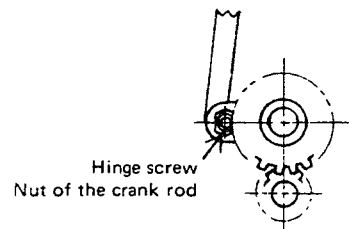


Fig. 54

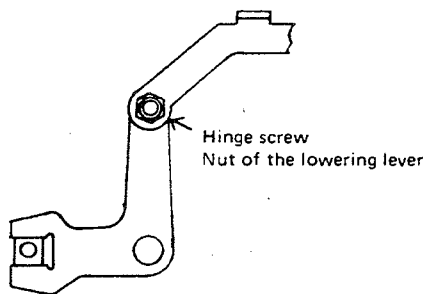
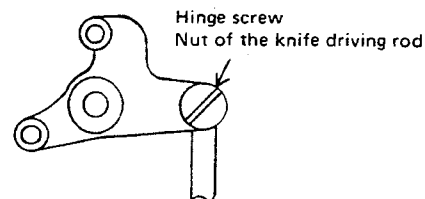


Fig. 55



(5. Shuttle Driver Shaft Components)

Fig. 56

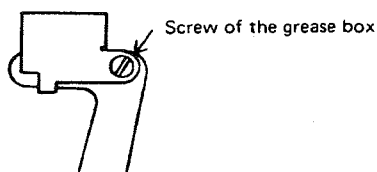


Fig. 57

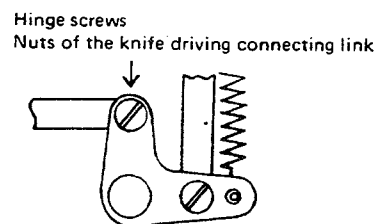


Fig. 58

(Note) When applying "Lock-tight" paint to the above-mentioned parts, take care not to contaminate neighboring parts with the paint, or the contaminated parts may cause malfunction.

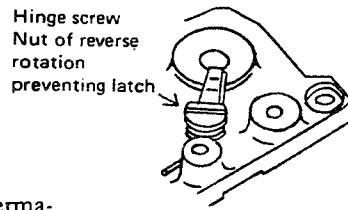


Fig. 59

In addition to the above parts, the paint is permanently applied to the following parts;

- B2602-980-000 Stop-motion level installing shaft
- B2618-280-000 Stud (of starting lever)
- SS-6110510-SP Screw (of brake cam ring)
- SS-1110821-TP Screw (of feed plate carrier bar guide plate)
- B1125-280-000 Tension thread guide (L-shaped)
- B1126-280-000 Silicon oil pipe
- B3114-771-000 Take-up thread guide
- SS-6110620-TP Screw (of work clamp foot lifting lever, small)
- NS-6720440-SP Nut (of knife driving connecting link)

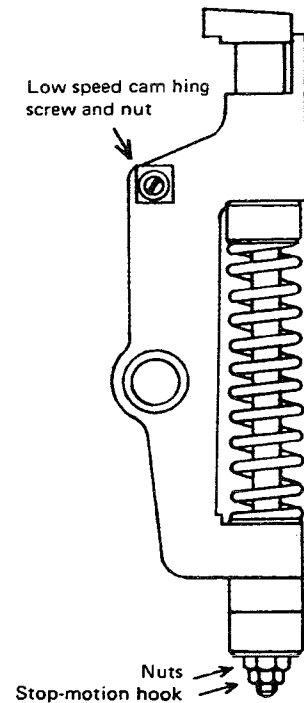


Fig. 60

**(13) Greasing**

- 1) Grease up the parts shown by Fig. 61 to 69 once in every 2 years and whenever they are disassembled.
- 2) Type of grease  
Lithium base grease, cone penetration 2.

Manufacturers	Trade name
ESSO	Listan 2, Beacon 2
SHELL	Albania

- 3) Method of greasing and the parts to be greased  
Use a grease gun. If it is not available, use a plastic oiler or an injector without a needle.

Front, intermediate and rear bushings of the main shaft

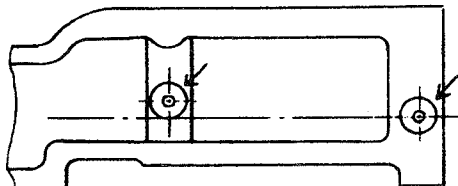


Fig. 61

Remove the rubber plugs from the top cover and apply the grease to the large holes in each bushing.

Rear end of the main shaft

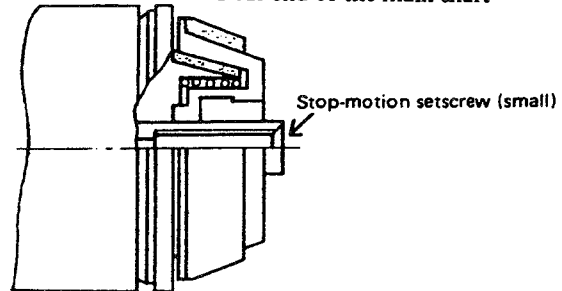
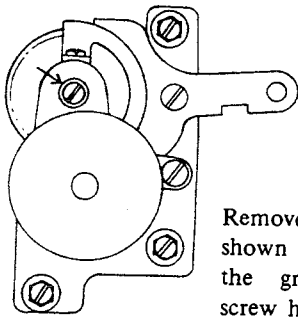


Fig. 62

Remove the driving pulley and also the spring in the mainshaft and fill the hollow in the shaft with the grease. But, take care not to apply too much grease, or the surplus grease may stain the surface of cork linings.

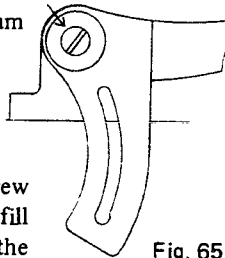
Pedal pressure decreasing unit



Remove the screw shown by arrow, give the grease into the screw hole and retighten the screw.

Fig. 63

Feed across regulator shaft of the feed cam components.



Remove the screw shown by arrow and fill the screw hole with the grease.

Fig. 65

Feed regulator shaft of the feed cam components

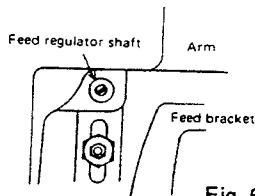
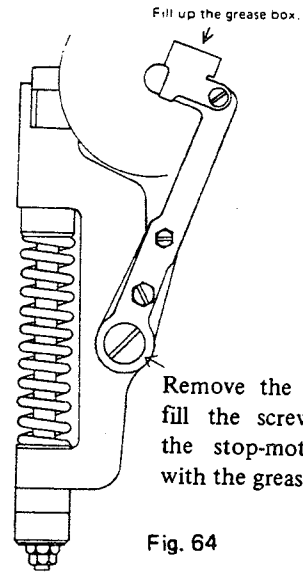


Fig. 66

Remove the screw shown by arrow from the rear of the machine arm and fill the screw hole with the grease.

Driving pulley pressing plate of the stop-motion mechanism



Fill up the grease box.

Remove the screw and fill the screw hole in the stop-motion lever with the grease.

Fig. 64

Stud of the stop-motion regulating lever

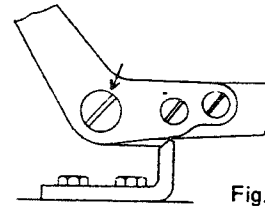


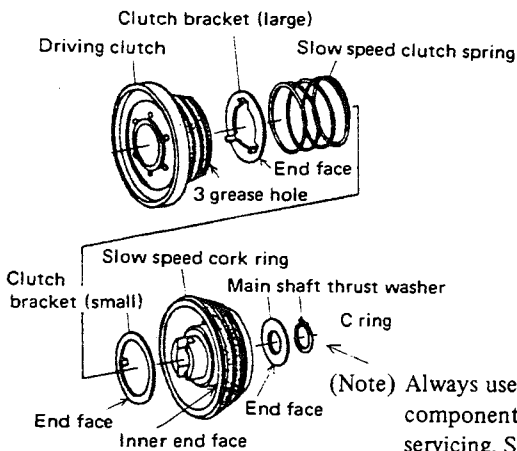
Fig. 67

Remove the screw from the stud shown by arrow and fill the screw hole with the grease.



Fig. 68

Oil felt on top of the stop-motion regulating lever



(Note) Always use a new C ring when assembling the clutch components after disassembling for greasing or servicing. Spare C rings are stored in the accessory box.

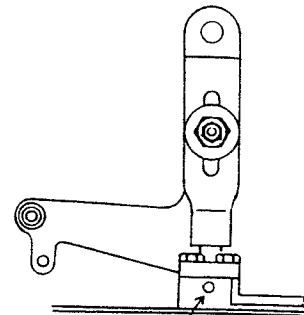
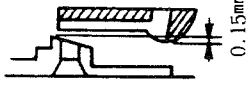
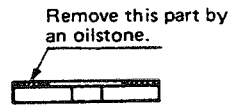
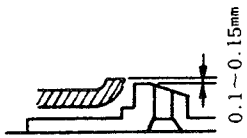
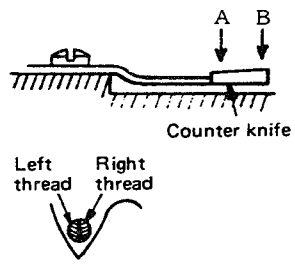


Fig. 69

Ball joint connection at the bottom of the feed regulator

**(14) Replacement parts**

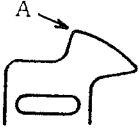
**A. Replacement parts normally required**

Part No.	Description	Remarks on replacement												
	Needle													
B1818-280-000	Shuttle	Provide a 0.3 to 0.5 mm (about 1/64") clearance at the shuttle driver. Refer to "Standard adjustment (1)."												
B2422-980-0A0	Moving knife	<p>1) Use a washer of suitable thickness for providing the moving knife with a difference in height of 0.15 mm between its lowest point and the highest point of the needle plate needle hole guide.</p>  <table border="0" style="margin-left: 40px;"> <tr> <td>B2423-280-00A</td> <td>Washer</td> <td>0.4 mm</td> </tr> <tr> <td>B2423-280-00B</td> <td>"</td> <td>0.5 mm</td> </tr> <tr> <td>B2423-280-00C</td> <td>"</td> <td>0.6 mm</td> </tr> <tr> <td>B2423-280-00D</td> <td>"</td> <td>0.7 mm</td> </tr> </table> <p>2) Since the used washer has a concaved part created by the hinged screw, make it flat by using an oilstone before installation. Otherwise, it will interrupt the action of the moving knife.</p> 	B2423-280-00A	Washer	0.4 mm	B2423-280-00B	"	0.5 mm	B2423-280-00C	"	0.6 mm	B2423-280-00D	"	0.7 mm
B2423-280-00A	Washer	0.4 mm												
B2423-280-00B	"	0.5 mm												
B2423-280-00C	"	0.6 mm												
B2423-280-00D	"	0.7 mm												
B2424-280-000	Counter knife	<p>1) Adjust the height of the counter knife by carefully using the blade of a screw driver so that its lowest point is 0.1 to 0.15 mm above the lowest point of the needle plate needle hole guide when the protruded part of the moving knife is passing by.</p>  <p>2) In order to evenly cut 2 threads at a time, the counter knife has a slanted blade. Pass 2 threads through the needle hole guide and check if they are evenly cut. If the right thread can not be sharply cut, increase the slope by carefully scraping the part (A). If the left thread can not be cut well, decrease the slope by scraping the part (B) with an oilstone.</p> 												
B2426-280-000	Needle plate needle hole guide	Replace it as soon as the needle hole is scratched or the needle hole has been enlarged. At the same time, correct the height of the counter knife as mentioned in the previous paragraph.												
B3112-761-000	Thread take-up spring	<p>1) After replacing the spring, check that the bolt of the tension post and the screw of the tension post socket are firmly tightened, because they will affect the thread trimming action.</p> <p>2) Also, check the timing of thread release action according to "Standard Adjustment (13)."</p>												



Part No.	Description	Remarks on replacement
B2303-280-000	Tension release pin	
B2110-280-000	Spring (of wiper connecting arm)	Replace it when the wiper does not perform a quick action.
	V-belt	Replace it with a suitable one for the sewing speed by referring to the table in "Standard Adjustment (17)."

#### B. Replacement parts infrequently required

Part No.	Description	Remarks on replacement
B1234-980-000	Brake cork ring	Refer to "(2) How to assemble the clutch components."
B1235-980-000	Driving clutch	
B1247-980-000	Low speed cork ring	
B1215-280-000	Stop-motion cam latch	
B1217-280-000	Safety plate stopper spring	
B2611-980-000	Driving pulley pressing plate	As soon as its ball depressing part has been recessed, replace it.
B2624-980-000	Driving plate	Replace it as soon as the edge (A) has worn out to allow the moving knife to shake with a click when the machine runs at the low speed. 
B2613-280-000	Stop-motion regulating cam roller	At the same time, renew the stop ring (B2615-280-000), because the old one can not be used any longer.
B1255-980-000 B1256-980-000	Clutch bracket (large) Clutch bracket (small)	Replace them referring to page 25.

#### C. Replacement parts tending to be lost or accidentally broken

Part No.	Description	Remarks on replacement
B2549-280-000	7 balls for work clamp foot mounting plate 3 balls in the main shaft	1) Use a sufficient amount of grease to keep them in position. 2) Take care not to drop them in the driving pulley holes, or they will interfere with engagement of the clutch.
SS2060-220-SP	Screw (to install the needle plate needle hole guide)	
RC-1381001-KP	C-ring (to secure the low speed cork ring)	Take care not to deform the ring by opening too widely when attaching.

## VI. HINTS ON SUBCLASS MODEL MODIFICATIONS

### (1) Model Nos. and number of stitches

Standard models for large size bar tacking

Model	Number of stitches		Symbol
	Full cycle	Half cycle	
LK-980	42		
LK-982	28	14	M2
LK-983	36	18	M3
LK-984	42	21	M4
LK-985	56	28	M5
LK-986	64	32	M6
LK-987	72	36	M7
LK-988	84	42	M8
LK-989	96	48	M9
LK-990	108	54	MK
LK-991	116	58	ML
LK-992	128	64	MM

### (2) Designation of the exclusive parts Nos. of subclass models

D △ △ △ △ △ — △ △ △ — □ □ □ □

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z
△	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
B	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
C	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
D	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
E	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144
F	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168
G	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192
H	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216
J	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
K	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264
L	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288
M	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312
N	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336
P	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
Q	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384
R	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408
S	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432
T	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456
U	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
V	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504
W	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528
X	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552
Y	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576
Z	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600

Subclass model Nos. 1 to 499 ..... with standard arm  
 No. 500 and more ..... with special arm

**(3) Modifications to subclass models & necessary replacement parts**

Standard models are modified to subclass models as oriented by arrows;

Modification with the different number of stitches

Modification with the same number of stitches but divided into half-cycle tack

Parts to be replaced	Remarks
Feed cam	
Feed plate	Blank plate is available.
Work clamp foot (right)	Blank plate is available.
Work clamp foot (left)	Blank plate is available.
Stop-motion regulating cam	Different cam is used depending on the number of stitches.
Tension release link tripping segment	Different segment is used depending on the number of stitches.
Feed cam driving worm	Different worm is used depending on the number of stitches.
Work wheel	Different wheel is used depending on the number of stitches.

Parts to be replaced	Remarks
Feed cam	
Feed plate	Blank plate is available.
Work clamp foot (right)	Blank plate is available.
Work clamp foot (left)	Blank plate is available.
Stop-motion regulating cam	Two types of cams are available for different stitch distribution.
Tension release link tripping segment	Different number of segments is used for different stitch distribution. (Example) 96 to 48 stitches 1 to 2 segments 48 to 96 stitches 2 to 1 segments

Modification with the same number of stitches

Parts to be replaced	Remarks
Feed cam	
Feed plate	Blank plate is available.
Work clamp foot (right)	Blank foot is available.
Work clamp foot (left)	Blank foot is available.

plus

plus

plus

plus

plus

Modified subclass models

Modification with different stitch size

Modification: From the standard model	Replacement parts	Part No.
To increase the stitch to 24 mm (15/16") or more in the lengthwise direction	Work clamp foot mounting base	D2536-L9S-B00
	Pressing spring suspension	D2546-L9S-B00
To increase the stitch size to 70 mm (2-3/4") or more in the crosswise direction	Feed across driving arm connecting rod	D2524-L7V-V00
	Feed across driving arm	D2530-L7V-V00
To enlarge the bar tacking size	Pressing spring	D2545-L4B-B00
	Work clamp foot hook (right)	D2542-L9S-B00
	Work clamp foot hook (left)	D2543-284-K00

Modification with different needle size

Replacement parts	Part No.	Needle size	Remarks
Needle plate needle hole guide	D2426-282-C00	#11	
	B2426-280-000	#14 ~ #18	Standard
	B2426-280-00B	#19 or thicker	
Shuttle race ring	B1817-280-000	#11 ~ #18	Standard
	D1817-282-N00	#19 or thicker	
Needle bar	B1401-L7V-V00	DP x 17 #19 or thicker	Extra-heavy material or heavy denim
	B1405-F7V-V00	DP x 17 #19 or thicker	A layer of 10 sheets of cloths or thicker

**(4) Replacement parts for changing the number of stitches**

Model	No. of stitches	Worm wheel	Worm	Stop-motion regulating cam	Tension release link tripping segment
LK-982	28	D2204282A00	D2205982A00	D2612982A00A	D2304982A00
	14	D2204282A00	D2205982A00	D2612982X00A	D2304982A00
LK-983	36	D2204283Q00	D2205983Q00	D2612983Q00A	B2304980000
	18	D2204283Q00	D2205983Q00	D2612M3AD00	B2304980000
LK-984	42	B2204280000	B2205980000	E2612980000A	B2304980000
	21	B2204280000	B2205980000	D2612984D00A	B2304980000
LK-985	56	D2204L5RU00	D2205M5RU00	D2612M5WE00	B2304980000
	28	D2204L5RU00	D2205M5RU00	D2612M6CP00	B2304980000
LK-986	64	D2204L6BE00	D2205M6BE00	D2612M5WE00	B2304980000
	32	D2204L6BE00	D2205M6BE00	D2612M6CP00	B2304980000
LK-987	72	D2204M7VV00	D2205M7VV00	D2612M5WE00	B2304980000
	36	D2204M7VV00	D2205M7VV00	D2612M6CP00	B2304980000
LK-988	84	D2204L8BF00	D2205M8BF00	D2612M8WB00	B2304980000
	42	D2204L8BF00	D2205M8BF00	D2612M9BL00	B2304980000
LK-989	96	D2204L9SB00	D2205M9SB00	D2612M8WB00	B2304980000
	48	D2204L9SB00	D2205M9SB00	D2612M9BL00	B2304980000
LK-990	108	D2204LKBG00	D2205MKBG00	D2612M8WB00	B2304980000
	54	D2204LKBG00	D2205MKBG00	D2612M9BL00	B2304980000
LK-991	116	D2204LLBH00	D2205MLBH00	D2612M8WB00	B2304980000
	58	D2204LLBH00	D2205MLBH00	D2612M9BL00	B2304980000
LK-992	128	D2204LMBJ00	D2205MMBJ00	D2612M8WB00	B2304980000
	64	D2204LMBJ00	D2205MMBJ00	D2612M9BL00	B2304980000

- 1) Use the stop-motion notch (D2630-M8W-B00), 2 screws (SS4110910-TP) and 2 washers (WP0480856-SP) for the stop-motion regulating cam installed in the models LK-985 to 992.
- 2) When dividing the above-mentioned number of stitches into two, use 2 sets of above parts for each machine.
- 3) Similar to the above, 2 pieces of tension release link tripping segments must be used for each machine.

## VII. UTILIZATION OF SPECIAL COMPONENTS

### (1) Pedal system

Besides the standard one-pedal system, 2-pedal system and P-type system which has the work clamp foot lifting device components are available.

The relative components to be used for these pedal systems are as follows;

	Pedal pressure decreasing unit	P-type components	One-pedal parts	Additional parts
1-pedal type (standard)	○		○	
2-pedal type	○			○
P-type		○		○
Name and No. of parts	Pedal pressure decreasing unit (asm) B3001-980-0A0	Pedal type presser (asm) B3060-980-0A0	Starting lever bracket (asm) (1) B2629-980-0A0  Spring (1) (for starting lever) B2629-980-000  Screw (1) (for starting lever bracket) SS-661110-SP  Washer (1) (for starting lever bracket) WP-0651-001-SB	Pedal (1) B8101-232-000  Pedal adjusting plate (2) B8125-012-000  Bolt (M6) (2) (for pedal adjusting plate) SM9061-203-SE  Chain (1) B8103-232-000  S-Shaped hook (2) B8133-109-000

### (2) How to install the pedal type clamp foot lifting device components (P-type)

Remove the pedal pressure decreasing unit, pull out the cam roller (B2404-280-000, See page 9 of the Parts Book), push up the work clamp foot lifting lever of the P-type unit and position its notched end over the pin on which the cam roller had been placed, and lastly fasten the pedal with 2 screws.

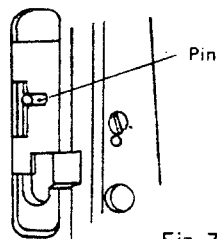


Fig. 70-a

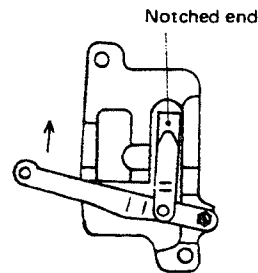


Fig. 70-b

### (3) Components for the low-speed machine

Sewing speeds and necessary parts:

- 1) A suitable combination of the motor pulley and the V-belt can be selected from the table in the Standard Adjustment (17) for the operation at 1,700, 2,000 or 2,200 s.p.m.  
Accordingly, the stop-motion regulating cam must be adjusted as mentioned in the Standard Adjustment (4) and (5).
- 2) For the operation less than 1,700 s.p.m., a low-speed stop-motion cam (D1214-MXC-J00) must be used.
- 3) For the operation at 1,400 s.p.m. with 60 Hz. power frequency, an idler pulley assembly (B7801-280-0A0) must be installed on the machine base so that the V-belt and the belt on the pedal pressure decreasing unit do not touch each other during operation.
- 4) For the operation less than 1,200 s.p.m., an additional speed reduction pulley unit must be installed on the bottom of the machine table.

**(4) Use of the special parts**

Applications	Description	Parts No.
When a long needle is used; (Needle : DP x 17, Di x 3)	Needle bar	D1401-L7V-V00
	Needle bar thread guide	D1405-L7A-M00
	Wiper	D2101-L7A-M00
When a thick needle is used; (#19 or thicker)	Shuttle	D1818-282-N00
	Shuttle race ring (when #23 is used)	D1817-282-N00
	Needle plate needle hole guide (with a boss)	B2426-280-00B
	Needle plate needle hole guide (without boss)	D2426-L7A-M00
When a thick thread is used;	Thread take-up spring	D3112-L4B-B00
	Tension spring No. 2	B3129-053-000
When increasing the stitch size in the crosswise direction by 25%; (Use a larger work clamp foot and feed plate to allow the needle freely pass through.)	Feed across driving arm	D2530-L7V-V00
	Feed across driving arm connecting rod	D2524-L7V-VA0
When increasing the working angle of the shuttle (for sewing canvas etc.)	Oscillating rock shaft	D1805-MLB-H00
When increasing the pressure given to the material;	Pressure spring	D2545-L4B-B00
When increasing the space on the needle plate;	Needle plate (110mm or 4" wide)	D2425-L9S-B00
	Needle plate (200mm or 7-7/8" wide)	D2425-L7V-V00
When the right work clamp foot is required to be lifted up independently by hand after the both feet are lowered; (for inserting a separate cloth piece)	Work clamp foot hook	D2543-284-Y00

**(5) Feed bracket components for large size bar tacking**

When sewing a large-size bar tacking stitch exceeding a lengthwise feed of 24 mm (61/64"), not only the feed bracket and blank work clamp foot illustrated later but also other relative components must be replaced as listed below;

<u>Part No.</u>	<u>Description</u>
D2536-L9S-B00	Work clamp foot mounting base
D2542-L9S-B00	Work clamp foot hook (right)
D2543-284-K00	Work clamp foot hook (left)
D2560-L9S-B00	Work clamp foot slide plate (right)
D2561-L9S-B00	Work clamp foot slide plate (left)
D2546-L9S-B00	Pressing spring suspension
D2545-L4B-B00	Pressure spring (2)
SS1110640-TP	Screw (2) (to set the work clamp foot)
SS6151712-TP	Screw (to set the feed bracket)
WS-0651510-KP	Washer (for the screw to set the feed bracket)
D9101-L9S-B00	Allen key wrench

**(6) How to use the work clamp foot and the blank feed plate**

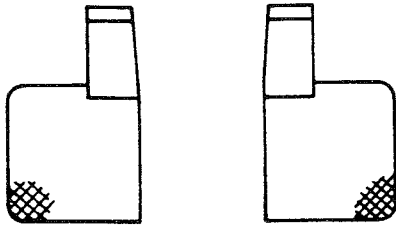
Although JUKI machine is shipped with the standard work clamp foot and feed plate, it is recommendable to change these components when an extra-heavy or fine material is sewn. In order to meet special applications, various work clamp feet and blank feed plates are available.

1) Different type of work clamp feet and feed plates

Type	Flat type	Inlay type	Stretch type
Application	Hard or thick cloth, leather, canvas, canton crepe etc.	Poplin and the like	Thin or soft cloth, knits, broadcloth etc.
Needle plate needle hole guide	D2426-284-Y00 for needle sizes #14, #16, #18 D2426-L7A-M00 for needle sizes #21 and #23 D2426-280-00B without boss	B2426-280-000 for large, small or buttonhole bar tacking D2426-284-M00 for shape bar tacking D2426-280-00B for needle sizes #21 or #23	D2426-282-C00 for knit goods bar tacking
Shape of work clamp foot and feed plate	The opening of the feed plate is smaller than that of the work clamp foot by about 0.2 mm as illustrated above.	The opening of the feed plate is larger than that of the work clamp foot by 1 mm (3/64'') as illustrated above.	
Features	Hard or thick cloth is flatly placed. The needle plate needle hole guide without boss will prevent the stitch from being skipped, because it does not permit the cloth to flutter during sewing. If cotton cloth flutters very little and is hard to form a well-tightened stitches, use a needle hole guide with boss and increase the pressure applied by the pressing spring on the work clamp foot mounting base.	The outer edges of the work clamp feet do not permit the cloth to slip sideways. Thus, stitch skipping is prevented.	The cloth is not allowed to flutter during stitching. Stitch skipping is efficiently prevented. When sewing 1 or 2 sheets of light-weight knits or half-broadcloth, this clamping method is indispensable.

2) Part No. of blank work clamp feet and feed plates

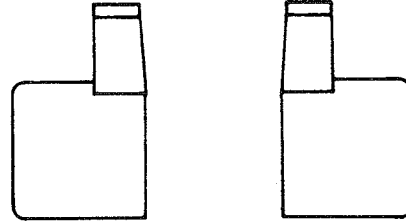
a. For the stitch size of 18 mm (45/64") (lengthwise) by 50 mm (1-31/32") (crosswise), use the following blanks:



**B2551-280-0V0**  
Blank work clamp foot  
(right), with embossed  
surface

**B2552-280-0V0**  
Blank work clamp foot  
(left), with embossed  
surface

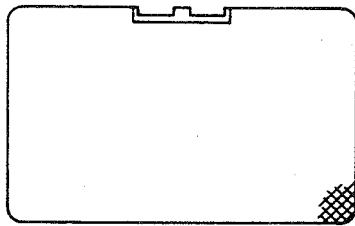
(Applications) Small-size bar tacking on heavy-weight materials



**B2551-280-0W0**  
Blank work clamp foot  
(right), with plain  
surface

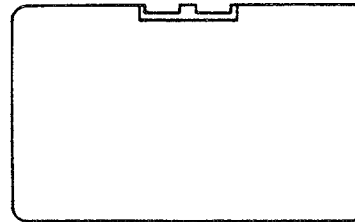
**B2552-280-0W0**  
Blank work clamp foot  
(left), with plain  
surface

(Applications) For preventing stitch-skipping when sewing light-weight materials by stretching the material with the protrusion of the foot



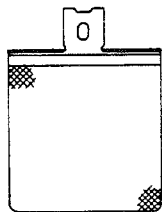
**B2551-280-0X0**  
Solid blank work clamp  
foot with embossed surface

(Applications) Solid work clamp foot for small-size bar tacking on the heavy-weight materials



**B2251-280-0Y0**  
Solid blank work clamp  
foot with plain surface

(Applications) Solid work clamp foot to securely clamp the light-weight materials with the protrusion of the foot



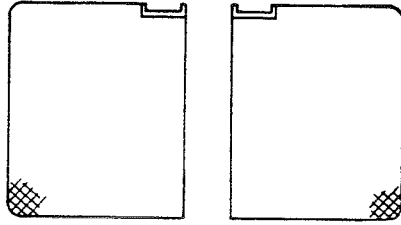
**B2519-280-0Y0**  
Blank feed plate

**Precautions**

- 1) The standard feed bracket (B2536-280-0A0) is used for each blank shown in this page.
- 2) Select suitable screws to set the blank foot to the feed bracket so that the bar tacking seam is positioned in the middle of the foot.
- 3) When installing a solid foot, cut off either tab which is not used for installation.



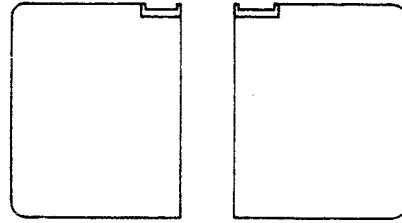
b. For the stitch size of 60 mm (2-23/64") (lengthwise) by 90 mm (3-35/64") (crosswise), use the following blanks;



**D2551-L9S-BV0**  
Blank work clamp foot  
(right) for large-size  
bar tacking, with  
embossed surface.

**D2552-L9S-BV0**  
Blank work clamp foot  
(left) for large-size  
bar tacking, with  
embossed surface.

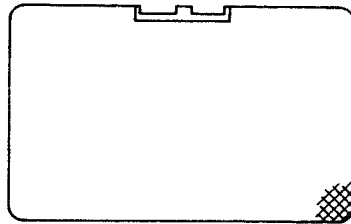
(Applications) Large-size bar tacking on heavy-weight materials



**D2551-L9S-BW0**  
Blank work clamp foot  
(right) for large-size  
bar tacking, with plain  
surface.

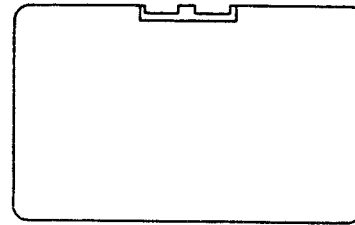
**D2552-L9S-BW0**  
Blank work clamp foot  
(left) for large-size  
bar tacking, with plain  
surface

(Applications) In order to prevent stitch-skipping when sewing large-size bar tacking on light-weight materials, an adequate protrusion is made on the sole of this blank work clamp foot.



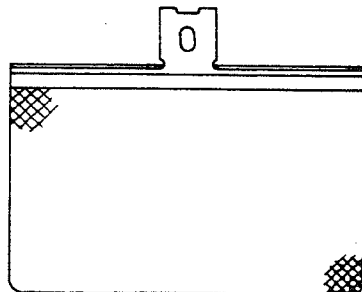
**D2551-L9S-BX0**  
Solid blank work clamp foot with embossed  
surface for large-size bar tacking.

(Applications) Large-size bar tacking on heavy-weight materials



**D2551-L9S-BY0**  
Solid blank work clamp foot with plain surface  
for large-size bar tacking.

(Applications) Large-size bar tacking on light-weight materials



**D2519-L9S-BY0**  
Large-size blank feed plate

#### Precautions

1) When the blanks described in this page are used, the following parts are also necessary;

**D2536-L9S-BA0** Feed blacket for large-size  
bar tacking

**D2560-L9S-B00** Work clamp foot slide plate  
(right)

**D2561-L9S-B00** Work clamp foot slide plate  
(left)

**SS1110640-TP** Screw (2) to set the work  
clamp foot

2) Determine the position of the screw hole to set the mounting base so that the bar tacking is sewn in the middle of the work clamp foot.

3) How to shape the blank work clamp foot

1. Set the work clamp foot mounting base onto the feed plate carrier bar by using one of A, B or C screw hole according to the size of bar tacking, as shown in Fig. 71.

	Lengthwise stitch size	Setting position (Screw holes, Fig. 71)
Standard feed bracket	0 to 18 mm (0 to 45/64")	B
	0 to 24 mm (0 to 15/16")	A
Work clamp foot mounting base	24 to 42 mm (15/64" to 1-21/32")	B
	42 to 60 mm (1-21/32" to 2-23/64")	C

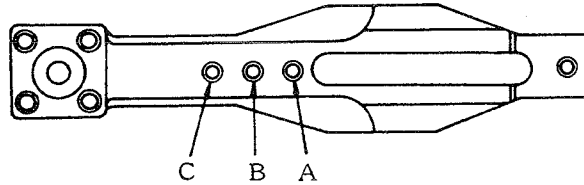


Fig. 71

2. Attach the blank foot.
3. Cut a needle so that its end lightly touches to leave a trace on the work clamp foot surface.
4. Turn the machine by hand to allow the needle leave the necessary traces on the surface of blank work clamp foot.
5. Cut out the blank work clamp foot 1 mm (3/64") outside of the traces left by the needle and bevel the edges at 30°.
6. It is advisable to provide the work clamp foot with a protruded part on the bottom when it is used for bar tacking the fine materials.

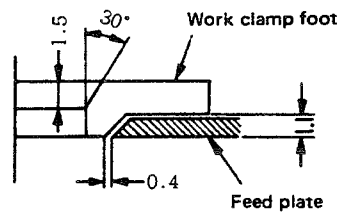


Fig. 72

The following shows main revisions that have been made in Engineer's Manual. (In this case, Management No. will be changed.)

Management No.	Month/year	Description
IV-8-1	Aug., 1983	<ol style="list-style-type: none"><li data-bbox="794 247 1422 338">1. Stop-motion notch positions have been increased. The hook positions for sewing speeds of 1700 s.p.m., 2000 s.p.m. and 2200 s.p.m. have been added. (P. 3)</li><li data-bbox="794 344 1422 407">2. The method of installing the driving pulley presser plate has been added (P. 12)</li></ol>

# JUKI

## JUKI CORPORATION

### HEAD OFFICE

2-1, 8-CHOME, KCKURYO-CHO  
CHOFU-CITY, TOKYO, JAPAN

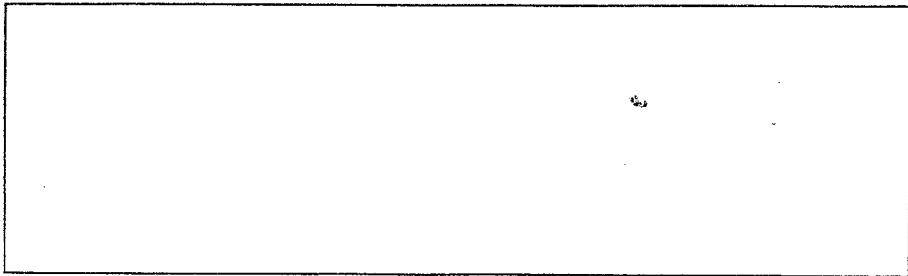
### BUSINESS OFFICE

23-3, KABUKI-CHO 1-CHOME,  
SHINJUKU-KU, TOKYO 160, JAPAN

CABLE : JUKI TOKYO

TELEX : J22967, 232-2301

PHONE : 03(3205)1188, 1189, 1190



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