

Shop Copy 2

2-1-93

**Nikon**

**OPTIPHOT - 66  
LABOPHOT BODY**

**REPAIR MANUAL**

This repair guide for a beginner as well as an experienced technician.

**NIPPON KOGAKU K.K.**  
Instruments group

OPTIPHOT, LABOPHOT

BODY

B, F, ER, UW-TUBE  
STAGE WITH VERTICAL HANDLE

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**CARE FOR STARTING REPAIR**

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**CARE FOR STARTING REPAIR**

- When carrying the microscope, hold its arm with one hand, and its base with the other.
- For replacement and others of the lamp bulb, do not touch it, after putting out the lamp, directly with the fingers.
- While the lamp is lighted, never bring any inflammable substances such as alcohol, gasoline, thinner, etc. near to the lamp housing.
- Take every caution in handling against shock.
- Be careful not to leave dust, finger marks, etc. on the lenses, lamp bulb, etc.
- Make sure of the power source voltage to be used (for example: LINE 100V, LAMP 6V, 20W), referring to the indication found on the transformer.
- Before replacing the fuse in the transformer, pull out the plug of the power source cord.
- For cleaning the lens surfaces, first remove dust, using a soft hair brush, or wipe it off lightly, using a gauze.
- Only for removing finger marks or grease, use a soft, clean cotton cloth, specified lens tissue or gauze, soaked with a bit of absolute alcohol (ethanol or methanol).
- For cleaning the parts painted or made of plastic, avoid the use of such organic solvents as alcohol, ether, thinner, etc.
- Do not use other tools other than the specified, except for an unavoidable case.
- Apply only specified oils to the parts, referring to the lubricant table, to keep up the efficiency of the instrument.

## TOOLS AND PREPARATIONS

## 1. Tools for General Use 2. Special Tools

## TOOLS AND PREPARATIONS

## 1. Tools for General Use

Name	Use
6 - screwdriver set	For screwing.
4 + screwdriver set	For screwing.
Pair of tweezers (stainless)	
Blower	For cleaning lenses, etc.
Injector (2cc)	For injecting oil.
Plastic or wooden hammer	For applying impact.
Hand lap	Container for alcohol
Hexagonal wrench	For set screws (3mm, 4mm). For HS bolts (3mm, 4mm, 5mm, 6mm)
Flat type thread driver	

## 2. Special Tools

Name	Number	Use
Substage condenser positioning tool	J25141 (Fig. 1)	For positioning substage and condenser
Tube receptacle/substage centering tool	J25142 (Fig. 2)	For centering tube receptacle and substage
Parallelism measuring base	J25143 (Fig. 3)	For rightangle of nosepiece to substage
Centered condenser	J25144 (Fig. 4)	For positional adjustment of base and arm
4X Objective		" "
Eyepiece CFW 10X		" "
Rightangle/Centering tool	J25145 (Fig. 5)	For adjusting rightangle of substage to nosepiece
Base axis collimator	J25146 (Fig. 6)	For OPTIPHOT
"	J25147 (Fig. 7)	For LABOPHOT
Standard vertical eyepiece tube (with Kellner eyepiece)		
Diopter adjusting telescope	J9008	For measuring tubelength and parfocality
Checker pattern reticle	J28004	For adjusting optical axis of eyepiece tube
Tension gauge 1Kg, 500g		For measuring torque
Centered objectives 10X, 40X	10X J28018 40X J28019	For checking travel accuracy of stage
Tubelength adjusting tool	J25148 (Fig. 8)	For measuring tubelength and parfocality
Collimator plane parallel		

TOOLS AND PREPARATIONS

2. Special Tools

- Substage/condenser positioning tool (J25141)

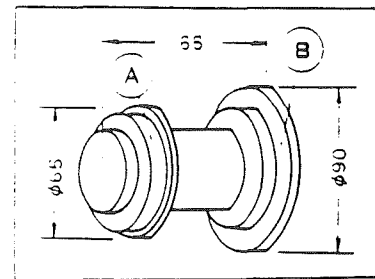


Fig. 1

- Tube receptacle/substage centering tool (J25142)

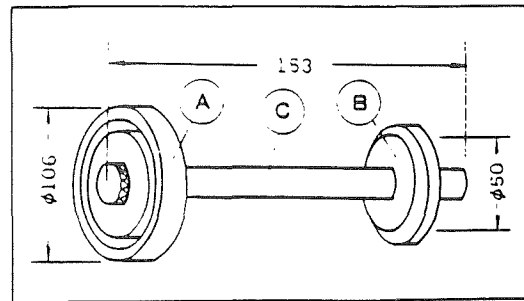


Fig. 2

- Parallelism measuring base (J25143)

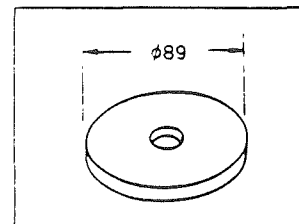


Fig. 3

- Now-eccentric condenser (J25144)

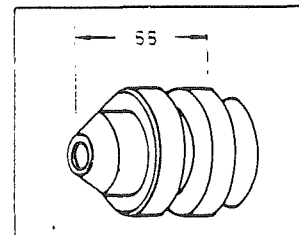


Fig. 4

- Substage rightangle/centering tool (J25145)

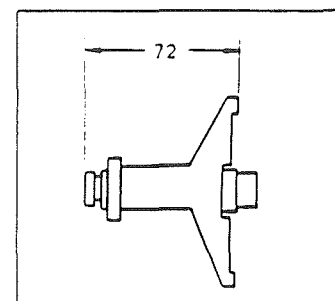


Fig. 5

## TOOLS AND PREPARATIONS

## 2. Special Tools

- Base axis collimator  
for OPTIPHOT  
(J25146)

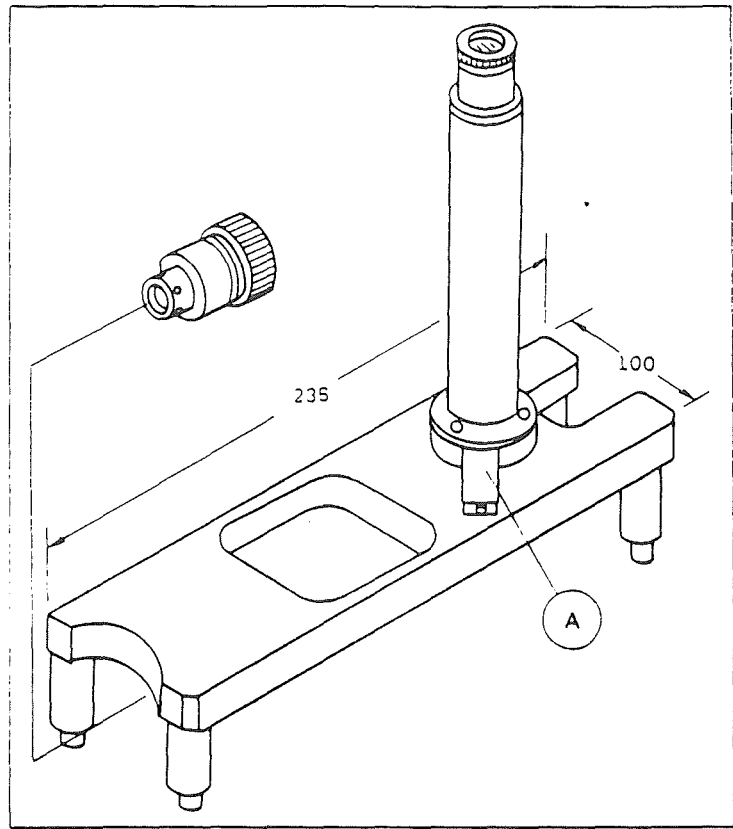


Fig. 6

- Base axis collimator  
for LABOPHOT  
(J25147)

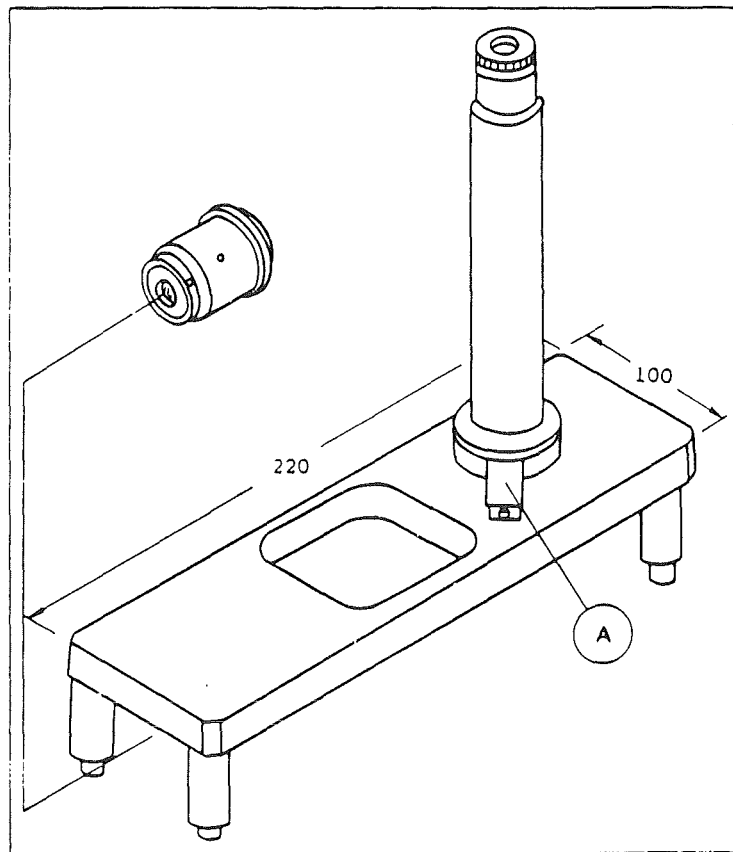


Fig. 7

- Tubelength adjusting tool  
(J25148)

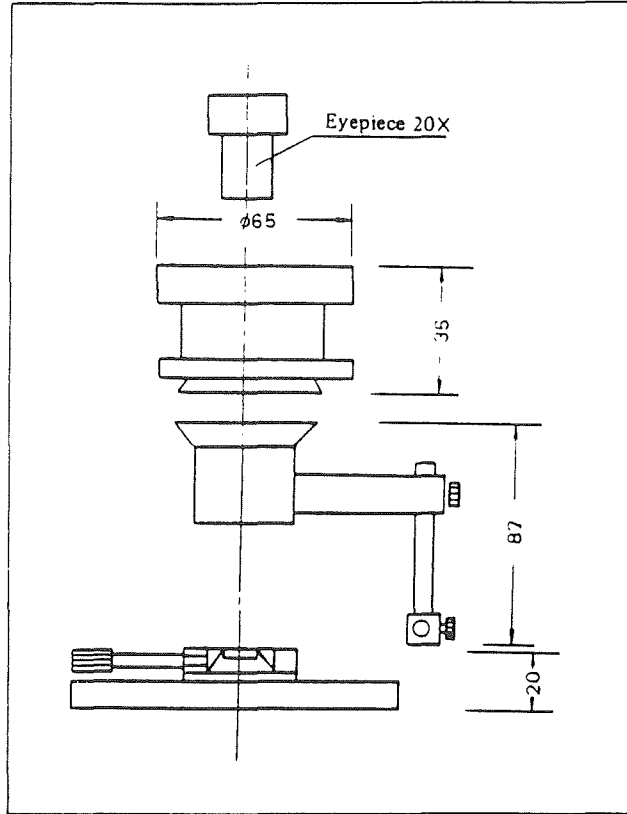


Fig. 8



3. Lubricant and Adhesive

(Coaxial coarse-fine focus unit)

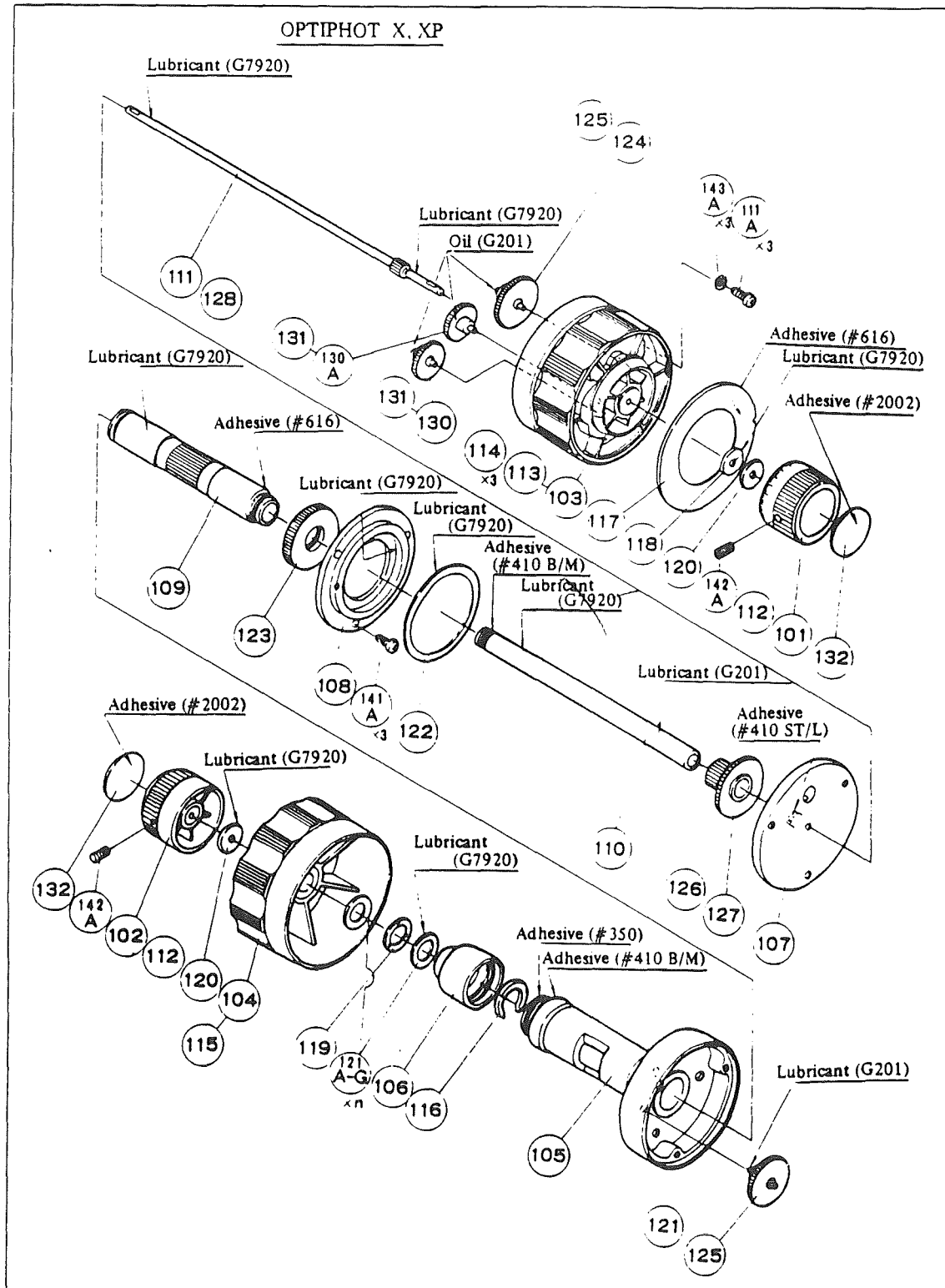


Fig. 9

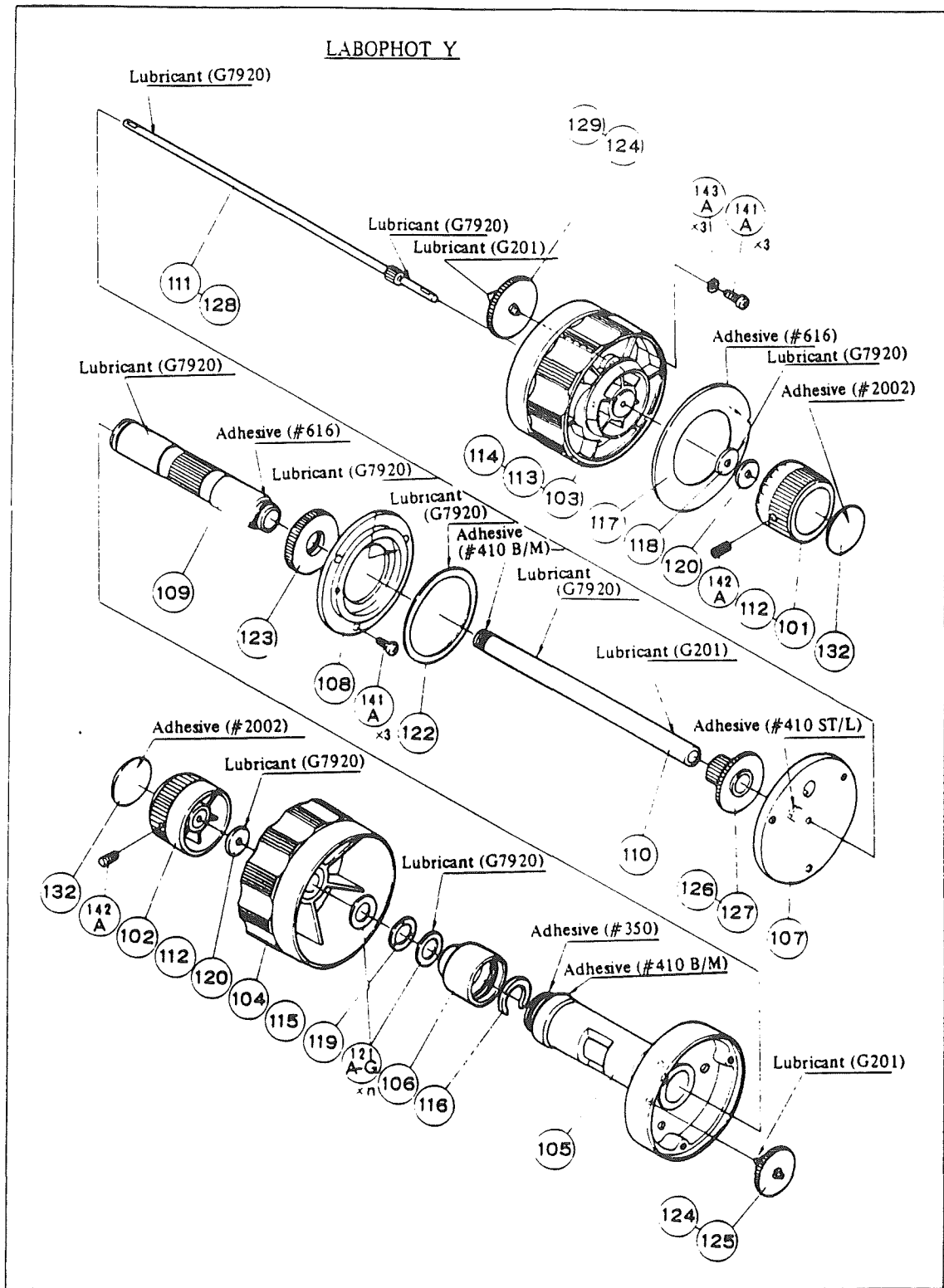


Fig. 10

TOOLS AND PREPARATIONS

3. Lubricant and Adhesive

(Substage Unit)

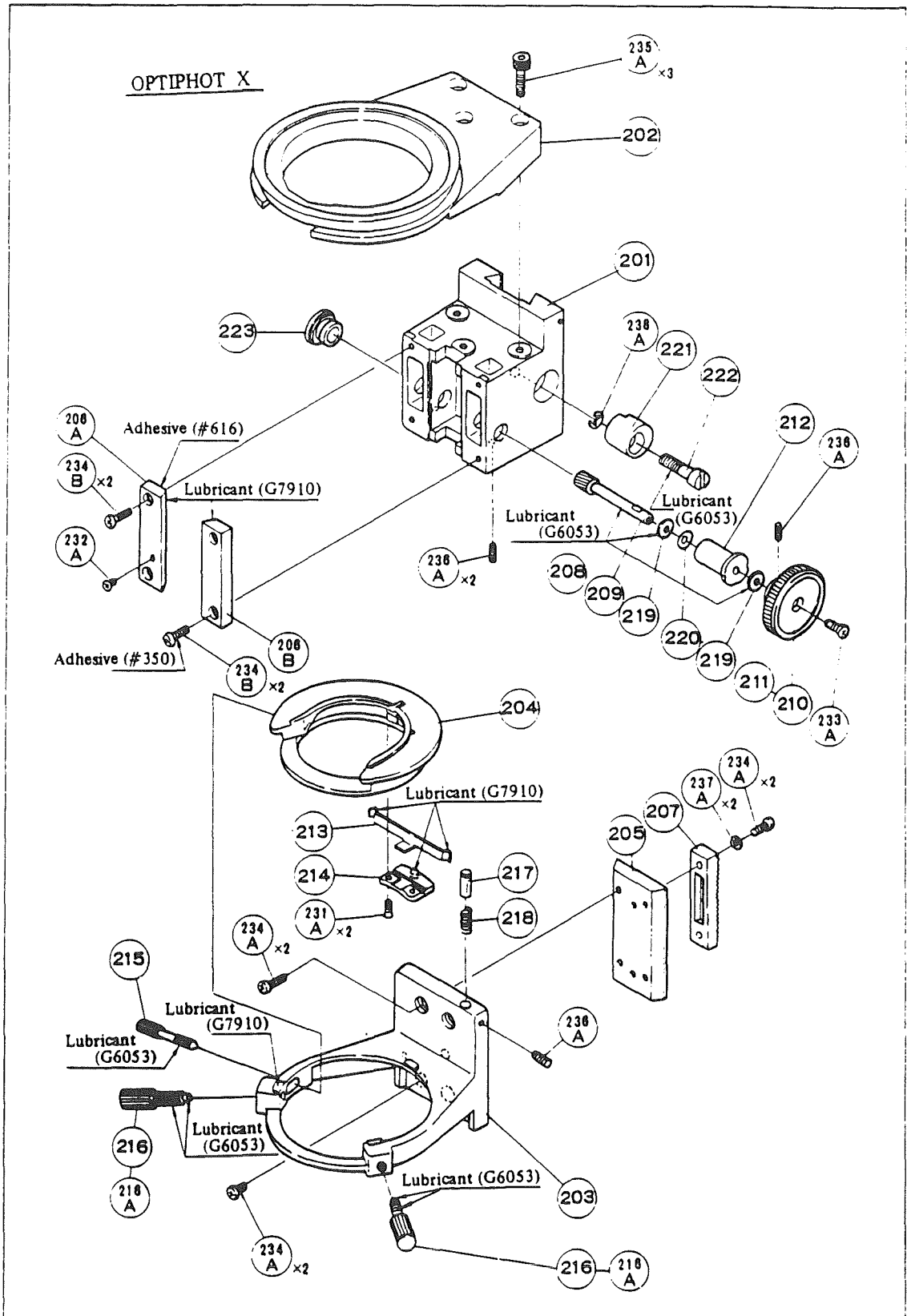


Fig. 11

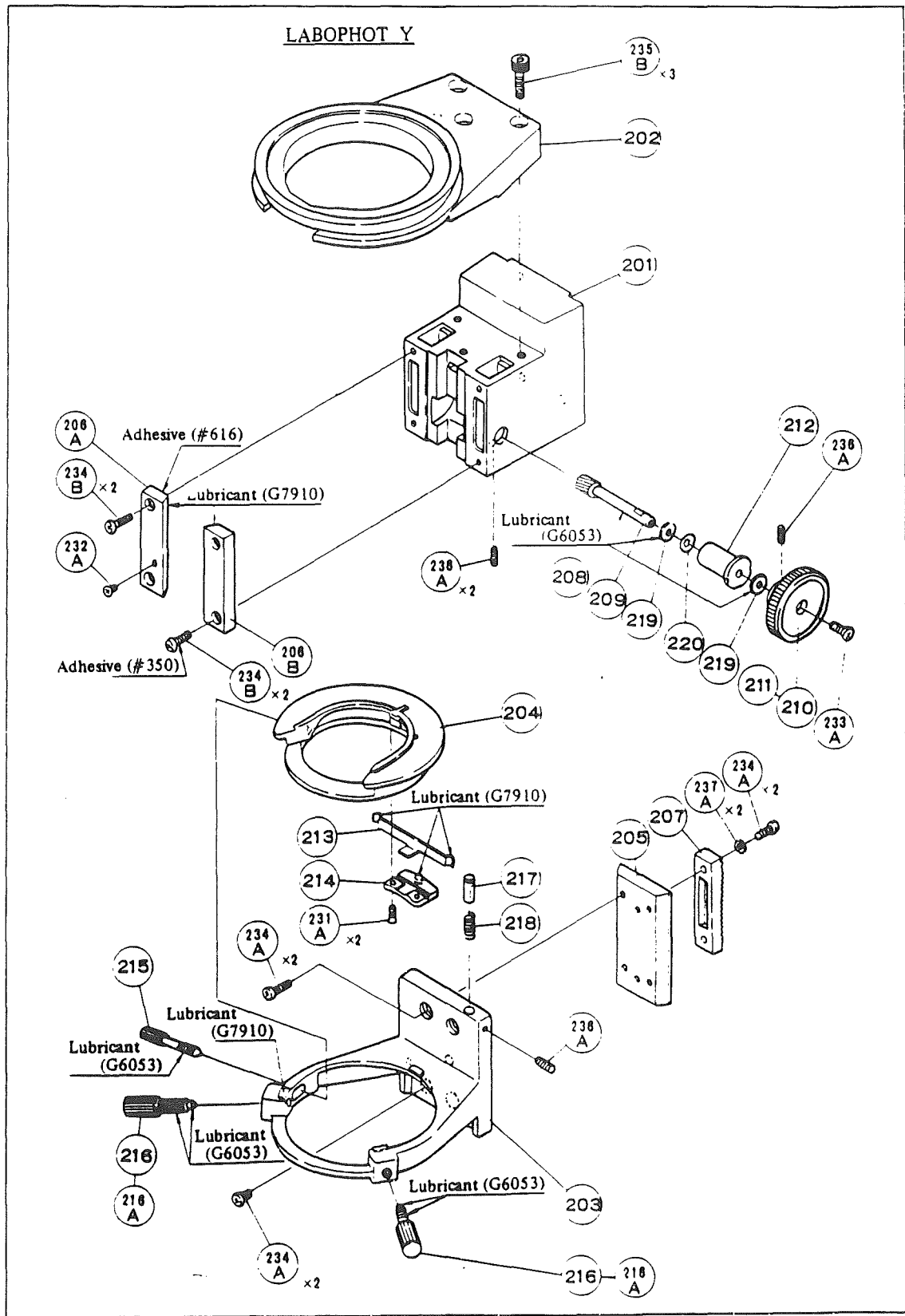


Fig. 12

TOOLS AND PREPARATIONS

3. Lubricant and Adhesive

(Arm Unit)

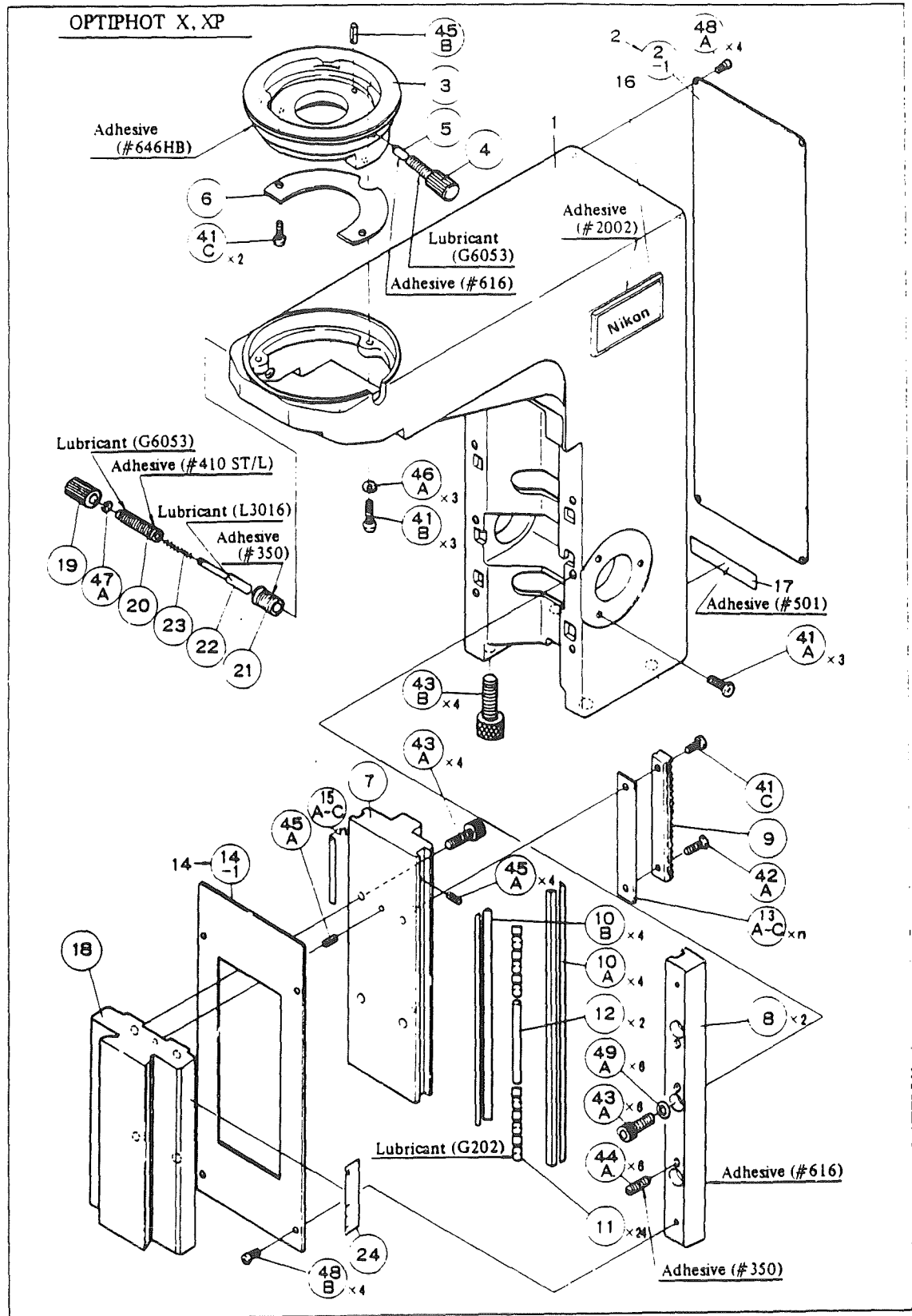


Fig. 13

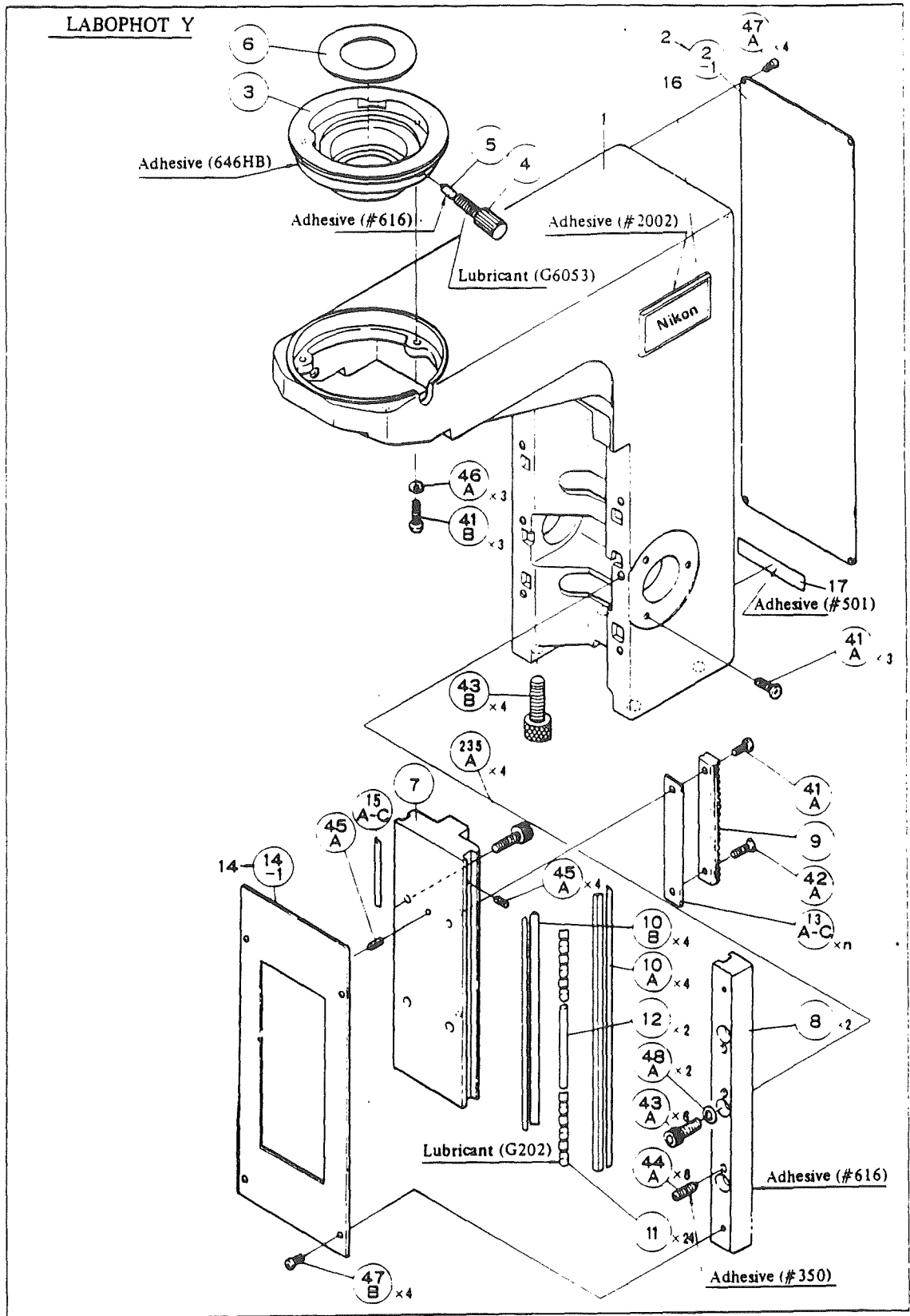


Fig. 14

(Nosepiece)

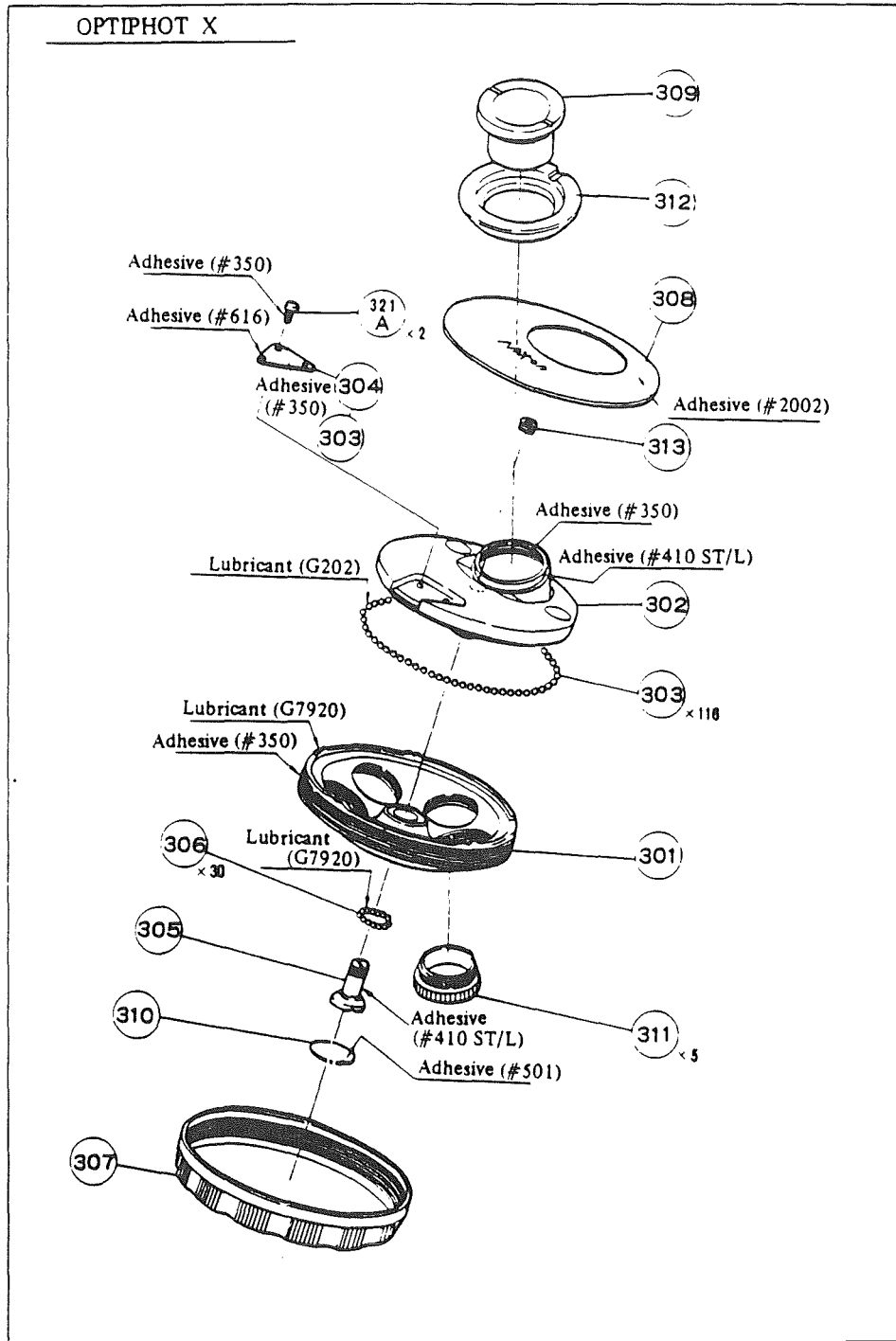


Fig. 15

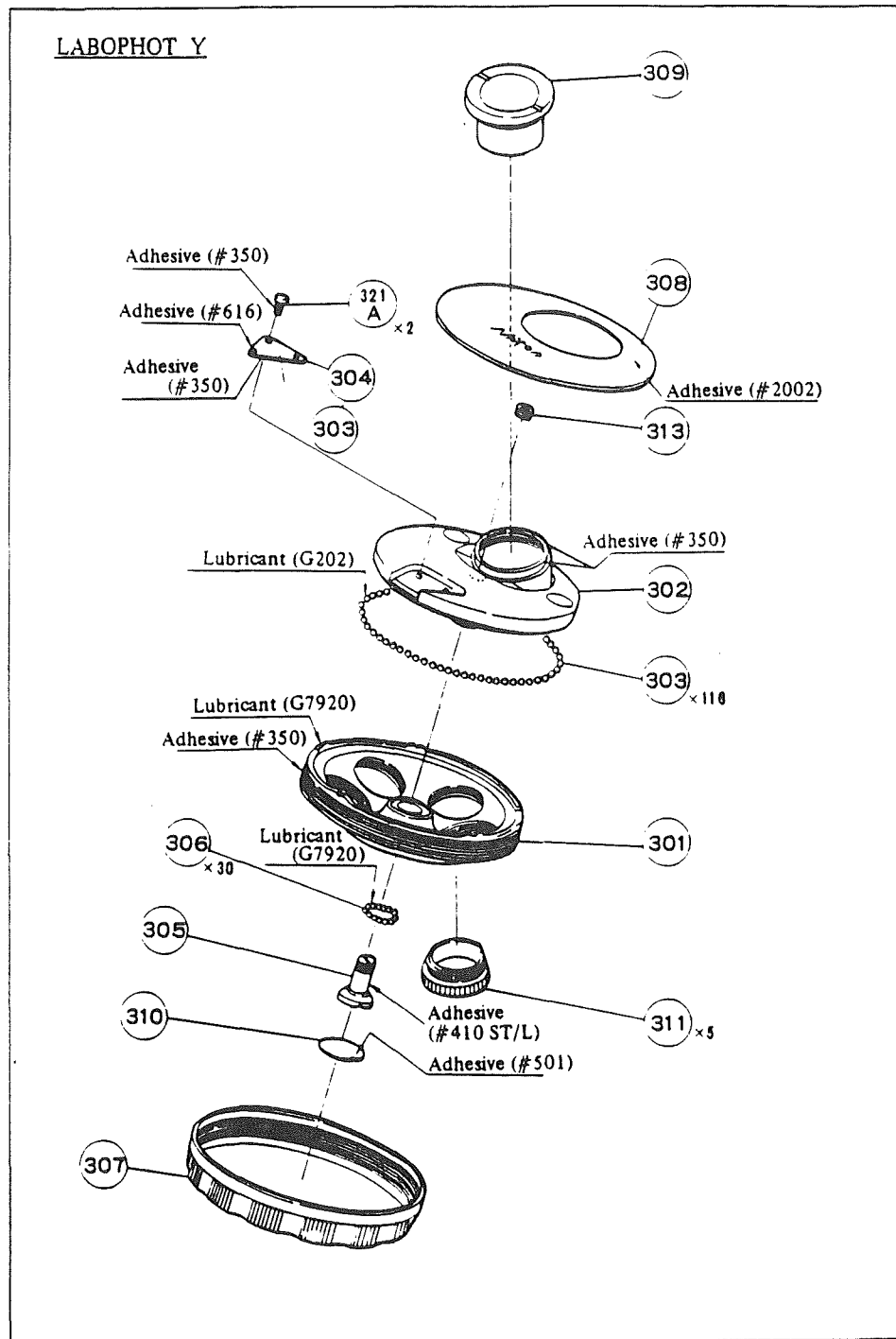


Fig. 16



TOOLS AND PREPARATIONS

3. Lubricant and Adhesive

(Base Unit)

Lubricant

(OPTIPHOT, LABOPHOT)

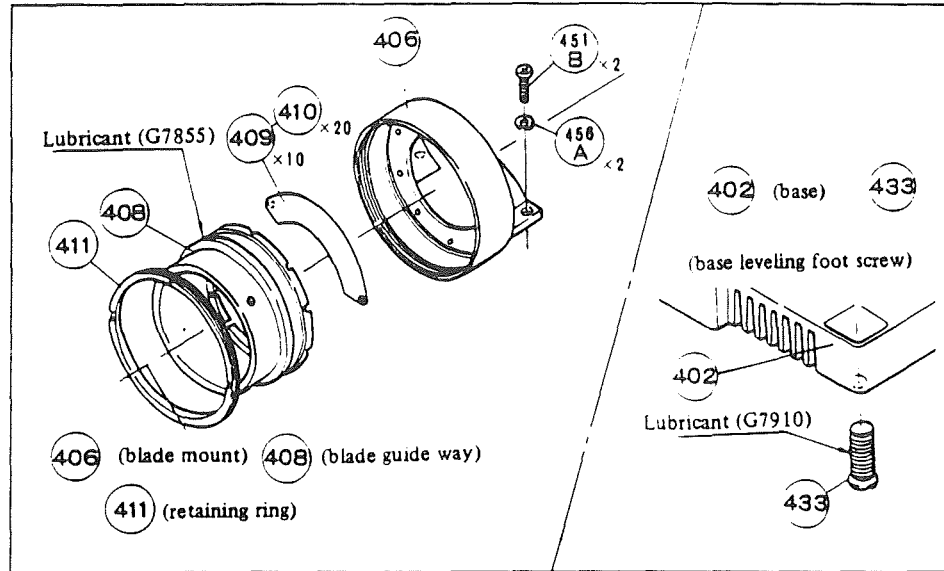


Fig. 17

Adhesive

(OPTIPHOT, LABOPHOT)

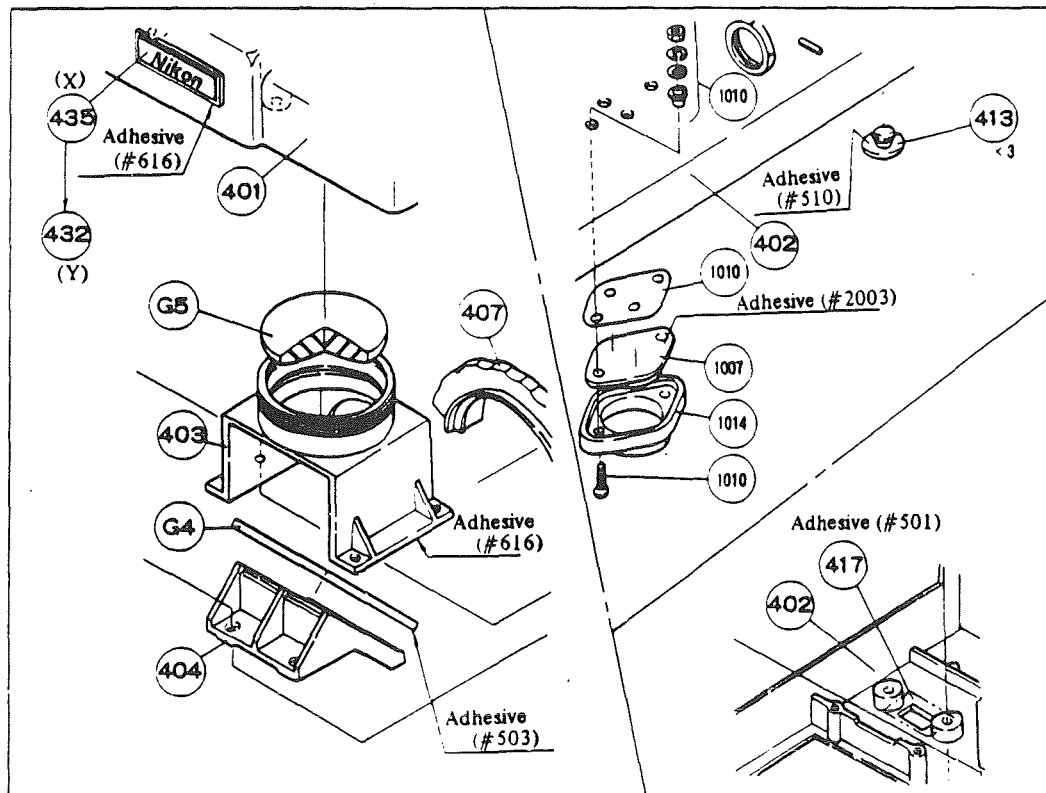


Fig. 18

(OPTIPHOT, LABOPHOT)

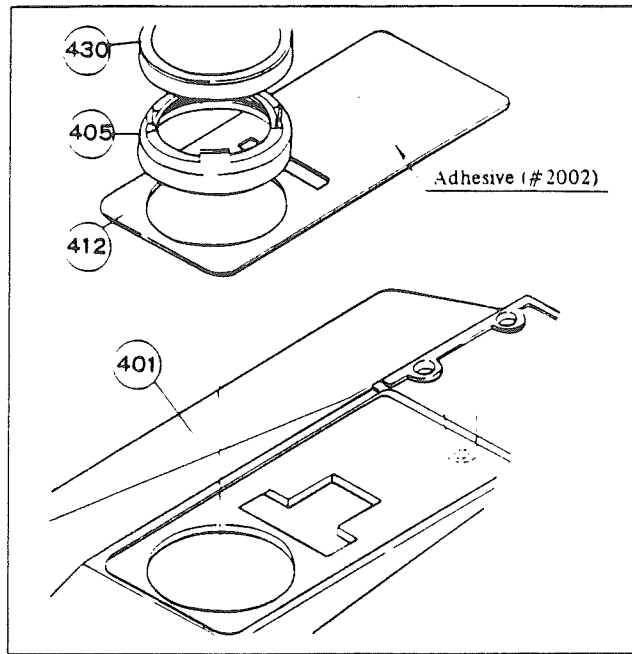


Fig. 19

(OPTIPHOT)

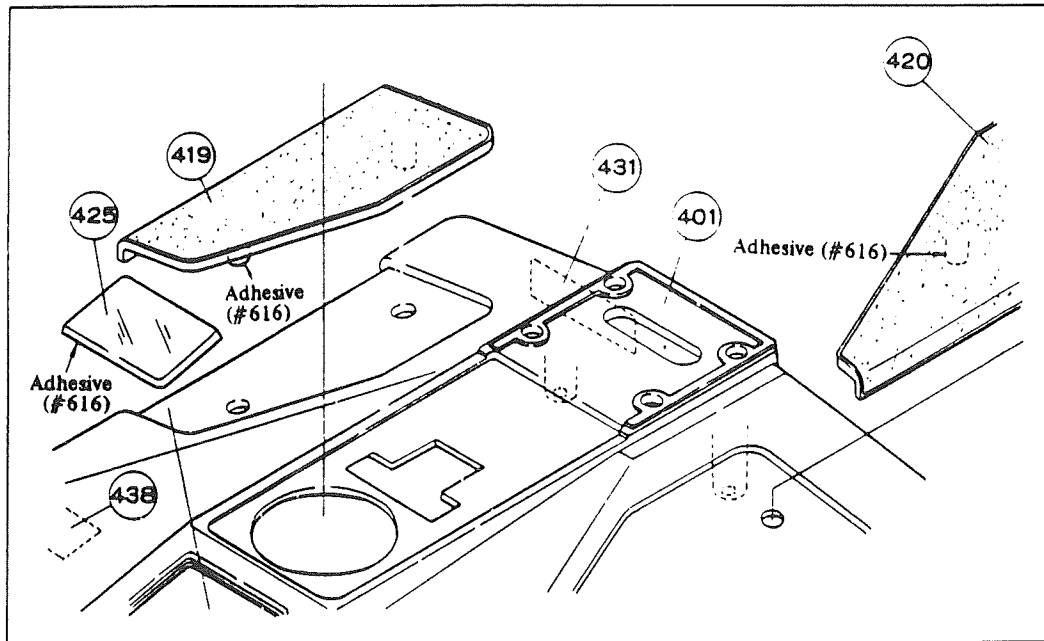


Fig. 20

(OPTIPHOT)

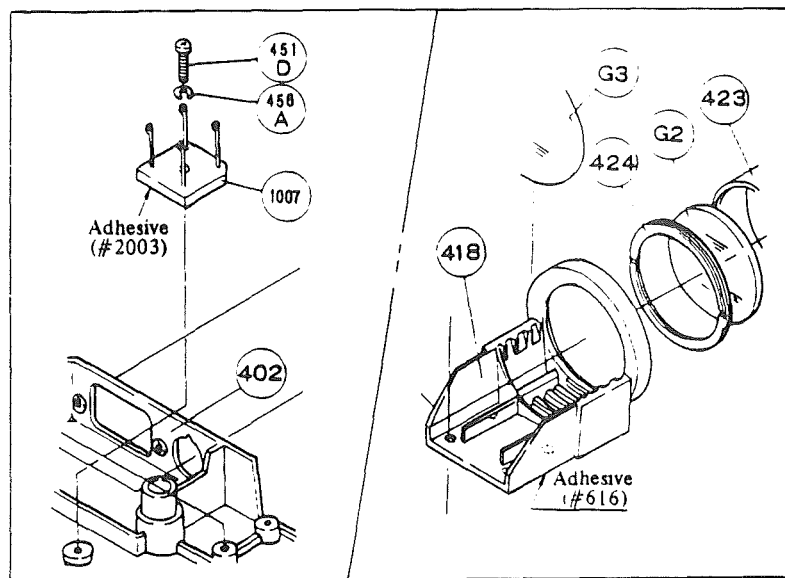


Fig. 21

(LABOPHOT)

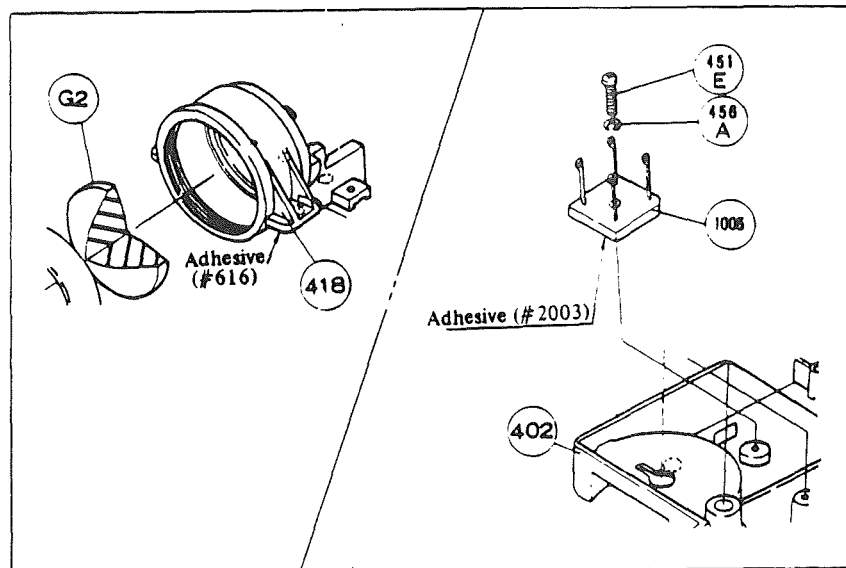


Fig. 22

(Lamp Housing)

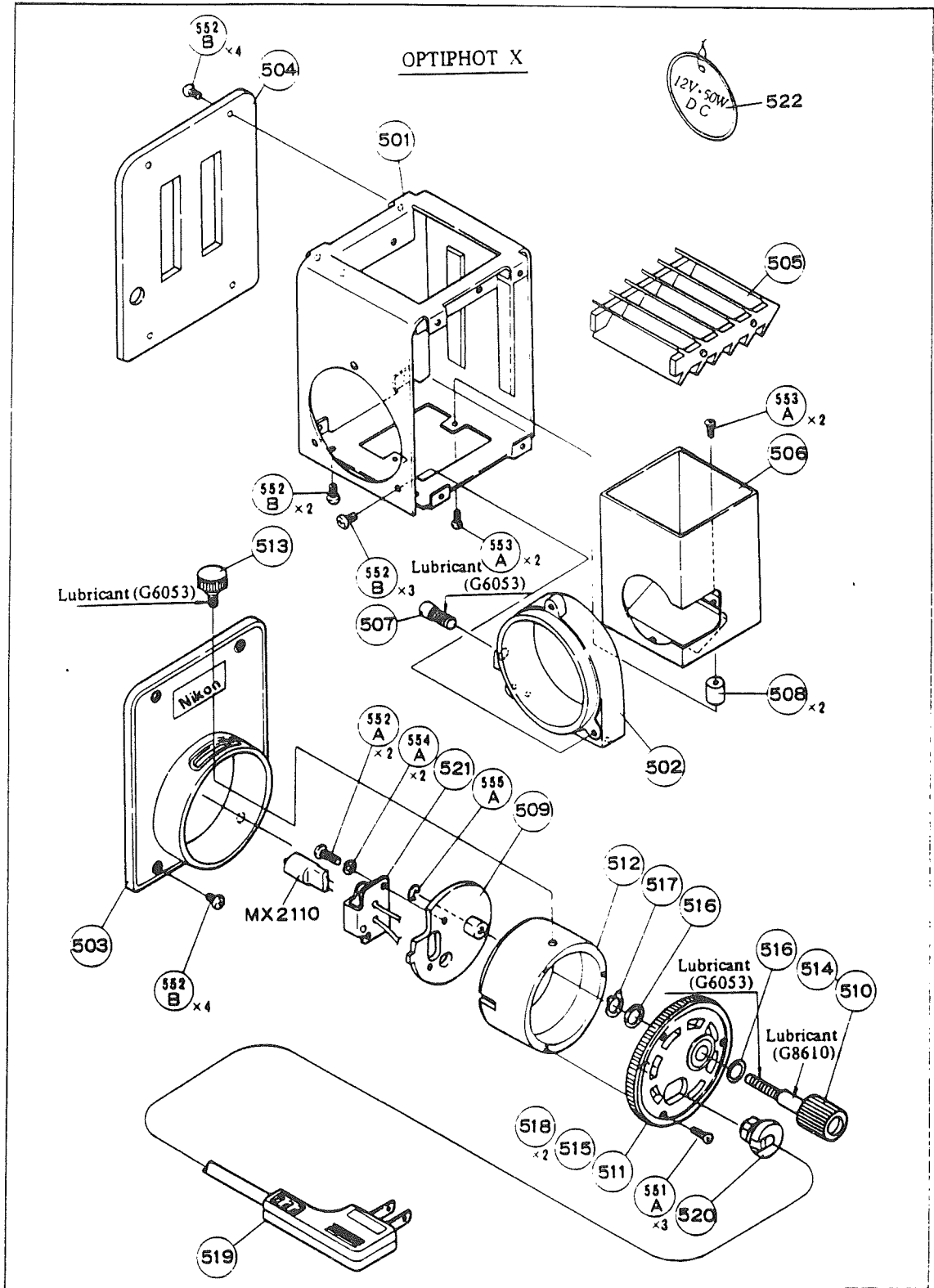


Fig. 23

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**TOOLS AND PREPARATIONS**

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**4. Others to be Repaired**

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**4. Others to be Repaired**

- Absolute alcohol
- Lens tissue

## MECHANISM AND PRINCIPLE

## 1. Coaxial Coarse and Fine Focus Unit

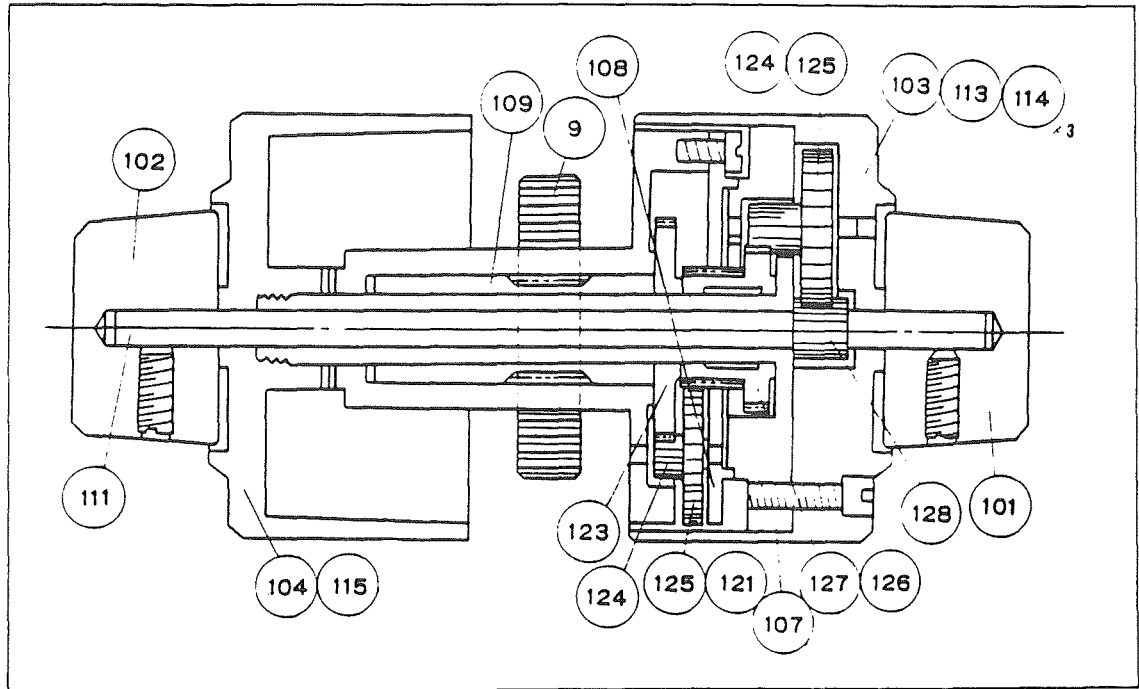


Fig. 24

## 1) Transmission of turning force of fine focus knob

- Turning force of the fine focus knob ((101) or (102)) is transmitted to the pinion shaft ((109)) to move the rack ((9)) vertically through the gear system ((128), (130), (130A), (125), (124), (127), (126), (125), (121), (123)).
- In this transmission with such a reduction ratio as from (126) to (109), the weight of the stage and substage, which exerts force to rotate (107), is overcome by the friction offered by spring ((118)) to the sliding surfaces of (107) and (108).
- Thus, even though some backlash is provided for each gear to enable smooth gearing, almost no slack will be seen in the rising and lowering directions of the stage, by virtue of the rotation force of the gears working in one direction under the weight of the stage.

## 2) Transmission of turning force of coarse focus knob

- No drop of the stage, which otherwise would occur while the coarse and fine focus knob is not operated, is due to the friction given by the spring (119) to the coarse focus knob, in the same way as in the case where the rotation force, produced under the weight of the stage and substage, even reduced through the whole system of gears, to turn the fine focus knob, is surmounted by the friction caused by the spring (118).
- In such a situation, when the coarse and fine focus knob (103 or 104) is turned, since no relative rotation between the coarse and fine focus knobs will take place, thus the gears (130), (130A), (125), (124) will not rotate on their axis in the coarse focus mechanism, but make the same rotation as the coarse focus knob, i.e. a revolution round the center of the pinion shaft.
- Therefore, when the coarse focus knob is turned, the gear (126) will make the same rotation as the coarse focus knob causing rotation to the pinion with the reduction ratio (126) to (125), (124) to (125).

Furthermore, in the staying position, even though the stage does not drop under its weight, the coarse focus knob will be moved by the turning of the fine focus knob.

This is on account of the fact that the change of the rotation force as well as the friction factor in the rotation position differ from those in the staying position owing to lubricant or the like.

## DISASSEMBLY PROCEDURE

## 1. Coaxial Coarse and Fine Focus Unit

## DISASSEMBLY PROCEDURE

## 1. Coaxial Coarse and Fine Focus Unit (OPTIPHOT, LABOPHOT) (Fig. 10)

- 1) Releasing HS screw (142A), remove the right ((101)) and left ((102)) fine focus knobs.  
In this case, take off plate spring (118) and washer (120), as well.
- 2) Rip off name plate (117) (cemented by No. 616) from the right coarse focus knob ((103)).  
After releasing set screws (11A) x3, take off (105) from gear case (107).
- 3) By removing (103) (together with bush (113) and bearing (114)), take off fine focus shaft (111), spur gears (128), (124) and (125), gear shaft (131), spur gear (130A) and gear shaft (131).  
(LABOPHOT: Spur gears (111) and (128), (124) and (129)) (Fig. 25)
- 4) Turn the left coarse focus knob (104) and coarse focus gear case (107), counterclockwise, to remove (104) (combined with bush (115)) from coarse focus shaft (110).  
In this case, (107) may separate from (110).

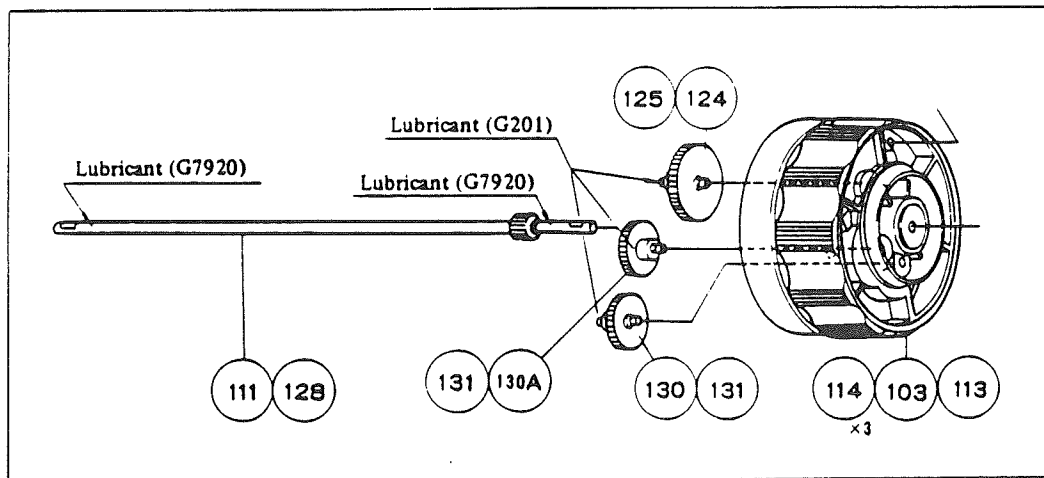


Fig. 25



## DISASSEMBLY PROCEDURE

## 1. Coaxial Coarse and Fine Focus Unit

- 5) Draw out coarse focus shaft (110). (Gears (126) and (127) will come in sight.)
- 6) Remove coarse focus bearing (108) as well as gears (121) and (125). (Fig. 26).

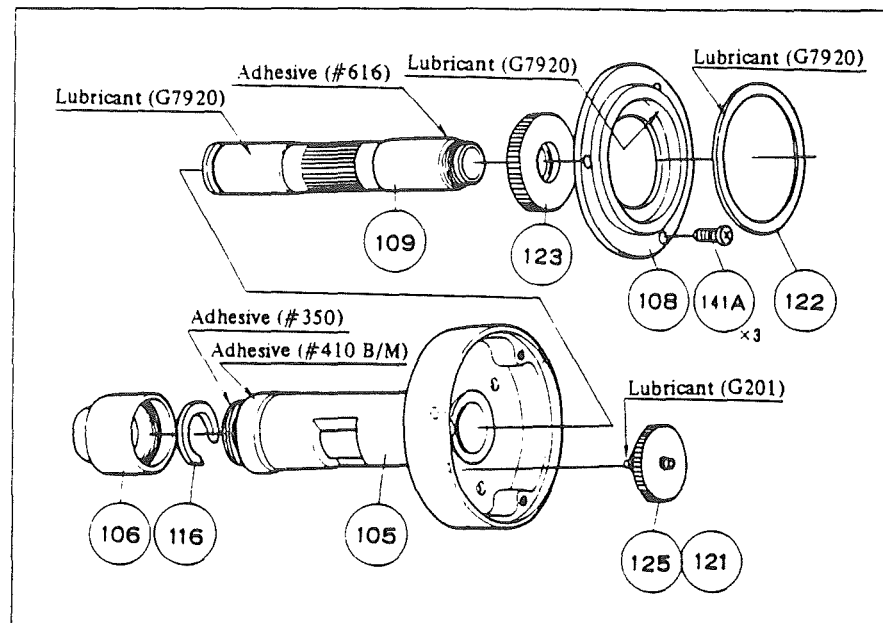


Fig. 26

- 7) Releasing HS bolts (43B) x4, separate the arm unit from the base.
- 8) Releasing PM screw (41C) and CM screw (42), remove rack (9).
- 9) Immersing the subassembly consisting of (105), (109), (123), (116) and (106) into alcohol, separate coarse focus bearing (106).

Furthermore, take off thrust loose stopper (116), and then pinion (109) and spur gear (123) can be taken out.

(109) and (123) are cemented with each other by No. 616 (Fig. 26).

Note: Pinion case (105) can be left attached on the main body.

**2. Substage Unit (OPTIPHOT, LABOPHOT) (Fig. 11, 12)**

- 1) To remove the substage as a unit, release clamp screw (222).  
(LABOPHOT: First, remove rear cover (2) and substage body (201) from roller race (male) (7)).
- 2) After releasing two set screws (236A) on the bottom of (201), remove pinion bearing (212). (Fig. 28).
- 3) Pinion (208) and pinion shaft (209) can be taken off, after condenser focus knob (210) (combined with bush (211)) has been removed. (Fig. 28).
- 4) After unscrewing PM screw (232A) on the (206A), remove the condenser carrier subassembly. (Fig. 28).  
Condenser centering mount (303) and dovetail (205) having been attached in the correct position, using the tool, it is not recommended to detach them, so far as no problem arises. (Fig. 28).

## DISASSEMBLY PROCEDURE

## 2. Substage Unit

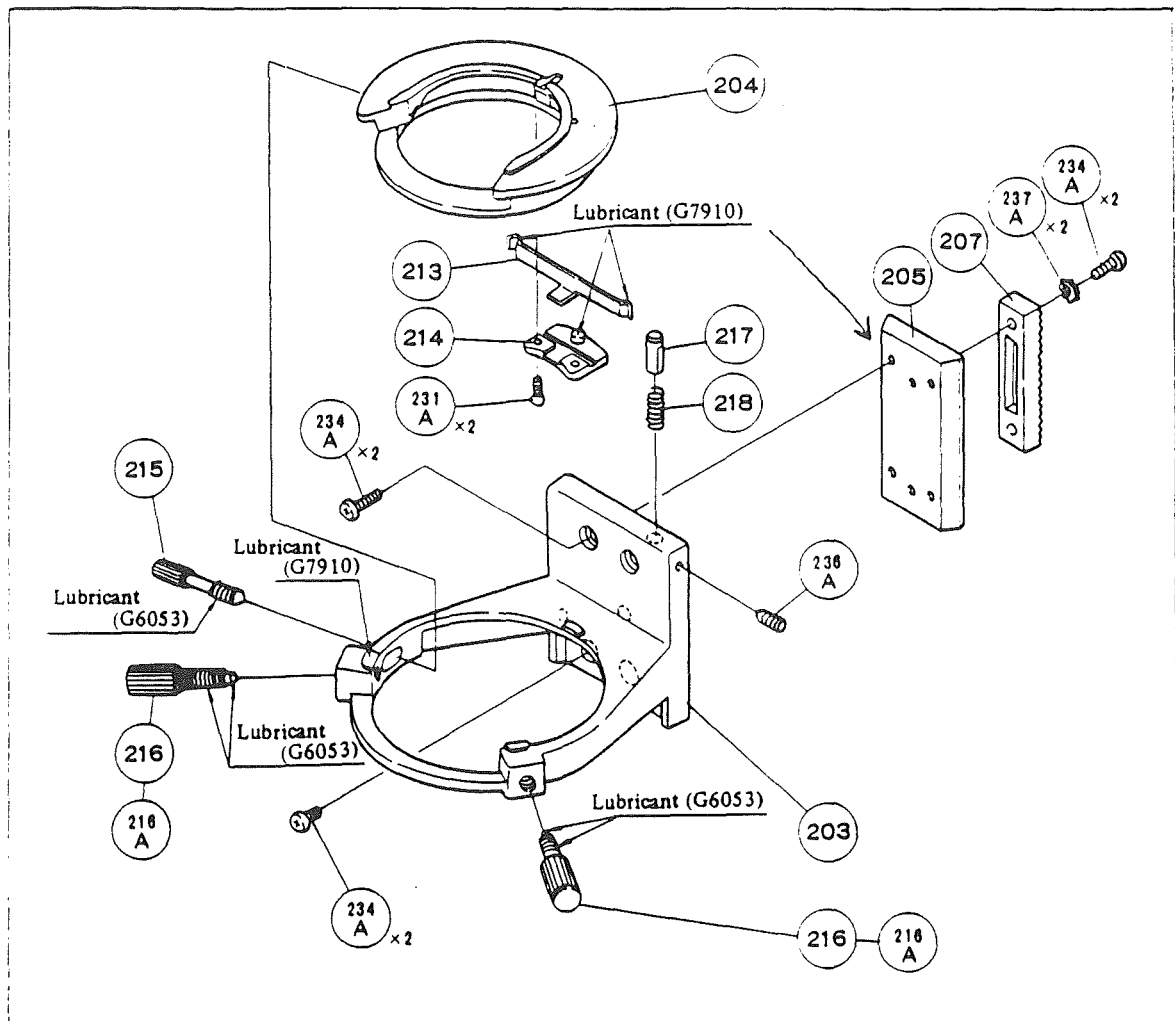


Fig. 27

- 5) Since of the two dovetail grooves ( 206A ) and ( 206B ), ( 206A ) is to be used as fiducial in reassembly, remove only ( 206B ) in disassembly. (Fig. 28).
- 6) If stopper pin ( 217 ) has once been separated, because the top end is liable to be damaged, use the new one, which will facilitate reassembling with high accuracy. (Fig. 27).
- 7) The other parts can be dismounted in any sequence.

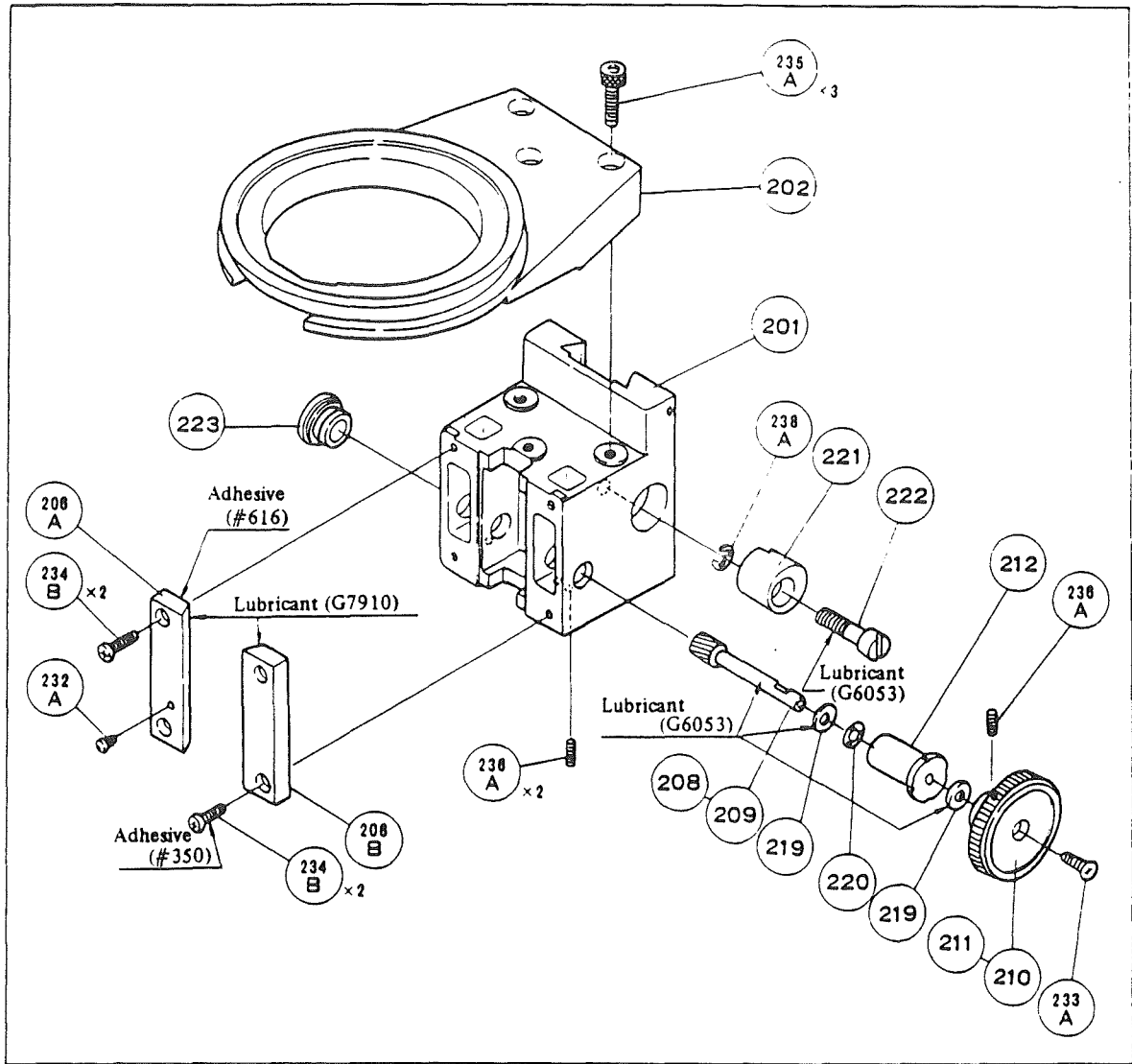


Fig. 28

## DISASSEMBLY PROCEDURE

## 3. Arm Unit

## 3. Arm Unit (OPTIPHOT, LABOPHOT)

- 1) Releasing HS set screws (48A) x4 (LABOPHOT: (47A) x4), take off rear cover (2).
- 2) Releasing HS set screws (43A) x4, take off dovetail (18) (LABOPHOT: Screw (235A) and dovetail (201) ) (Fig. 29).
- 3) Releasing HS screws (43B) x4 (LABOPHOT: (47B) x4), take off cover plate (14). (Fig. 29).

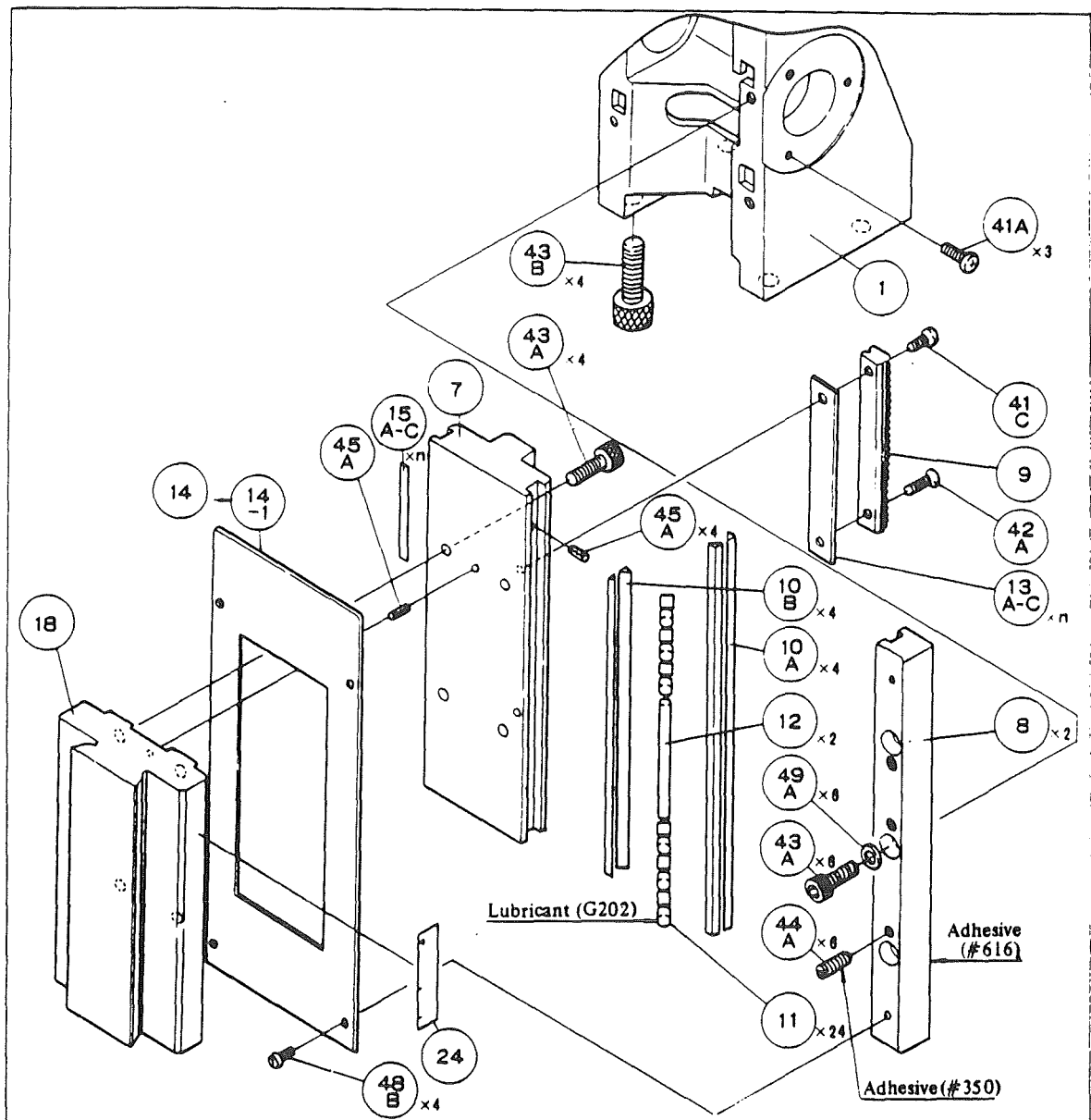


Fig. 29

## DISASSEMBLY PROCEDURE

## 3. Arm Unit

- 4) After removing bottom plate (402) from the base, and releasing (43B) x4, take off arm (1) from base body (401). (Fig. 29).
- 5) Releasing screws (41C) and (42A) (LABOPHOT: (41A) and (42A)), draw out rack (9) together with washers (13A) ~ (13C) toward the base. (Fig. 29).
- 6) Forcibly draw out roller race (male) toward the base. (Fig. 31).
- 7) Releasing screws (43A) x3, remove roller race (female) (8).  
(This (8) being cemented to main body (1) by (616), strike it with a wooden hammer).  
In this case, the lefthand (viewed from the user) race being to serve as fiducial in reassembling, remove only the righthand one. At this time, cylindrical roller (11) and retainer (12) will separate.

< The disassembly described below should be attempted only by an expert >

- 8) Nosepiece subassembly (only for OPTIPHOT)

Follow the sequence as follows (Fig. 32 and 33):

- i) Remove nosepiece clamp knob (19).
- ii) Take off clamp screw receptacle (21) from main body (1).
- iii) Remove E-ring (47A) to dismount clamp pin (22) and spring (23).
- iv) Nosepiece clamp screw (20) and screw receptacle (21), though cemented by No. 410 St/L, can be unscrewed, using an ordinary tool.

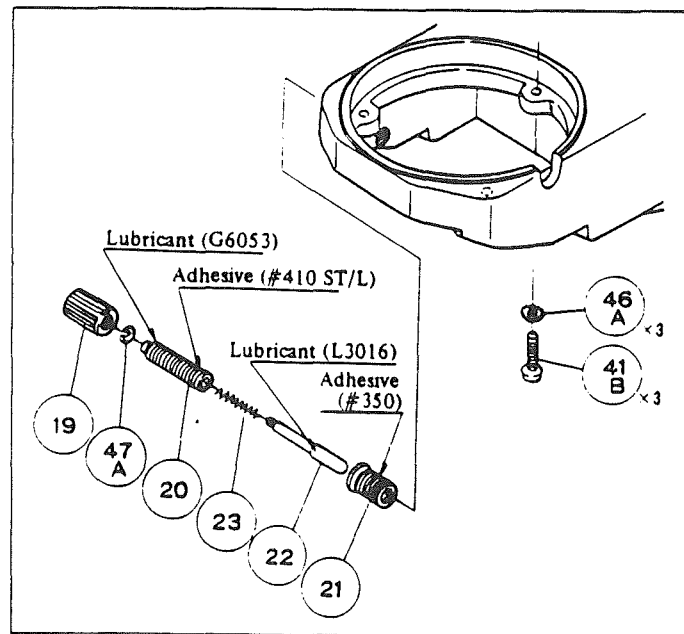


Fig. 30

## DISASSEMBLY PROCEDURE

## 3. Arm Unit

- 9) Release screws (41B) x3, and by striking tube receptacle (3) with a wooden hammer, take off the receptacle (3) from main body. (Fig. 31).

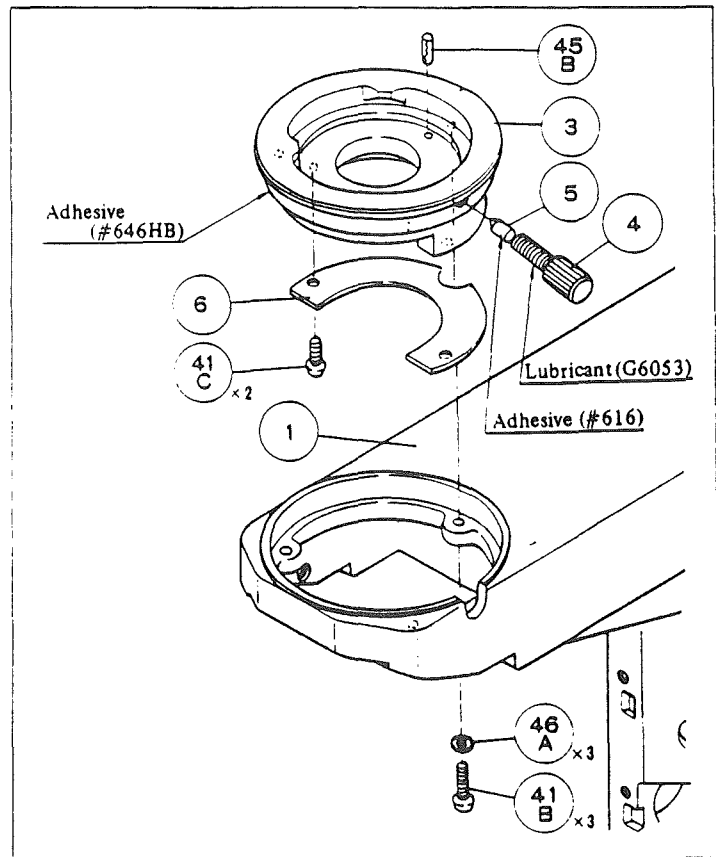


Fig. 31

## 4. Base Unit (OPTIPHOT, LABOPHOT)

- 1) Remove lens cap (405).
- 2) Releasing HS screws (452) x4, remove base (401) and bottom plate (402). Beforehand, take off (G5) and (G6) (only (G5) for LABOPHOT).

< Field diaphragm (Fig. 36 and 37) >

- 3) Releasing PM screws (451B) x2, remove blade mount (406) from bottom plate (402).
- 4) Remove field diaphragm controlling ring (407).
- 5) Remove retaining ring (411), and then blade guide way (408), blades (409) and dowel (410) will separate.

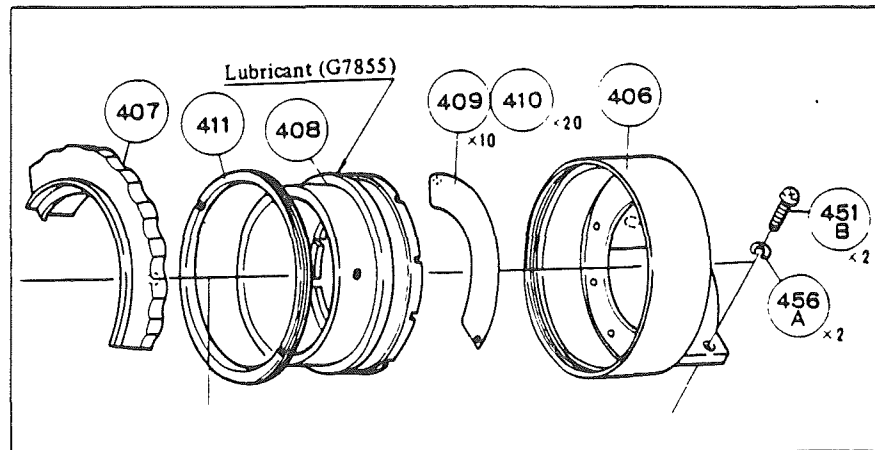


Fig. 32

- 6) Take out lens (422) (LABOPHOT: (418)) from filter receptacle (418) (LABOPHOT: From bottom plate (402)).
- 7) Remove retaining ring (424) (LABOPHOT: (427)), and then (G1) and (G2) (LABOPHOT: (G2) and (G3)), and spacer ring (423) (LABOPHOT: (429)) will separate.



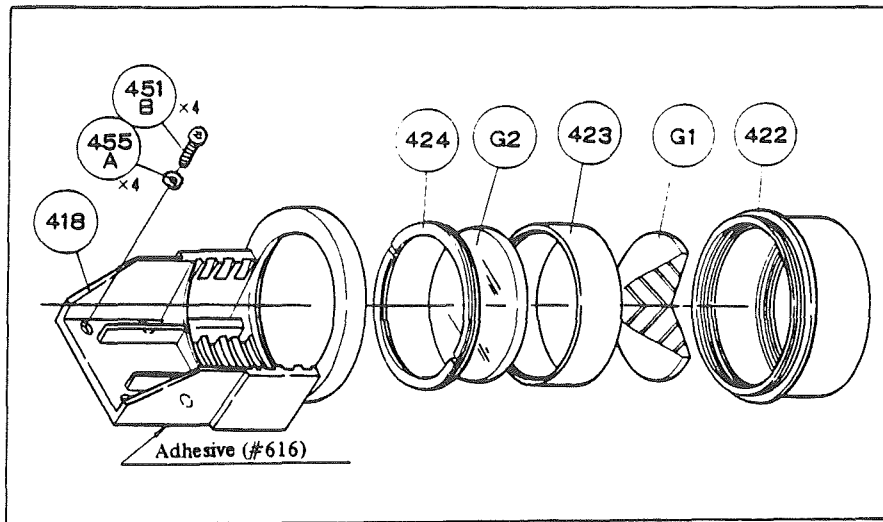


Fig. 33

< Removing variable resistor (1004) (LABOPHOT: (1003)) (Fig. 34) >

- 8) Take off brightness control dial (414) and bush (415).
- 9) By removing the nut, variable resistor (1004) (LABOPHOT: (1003)) can be separated.

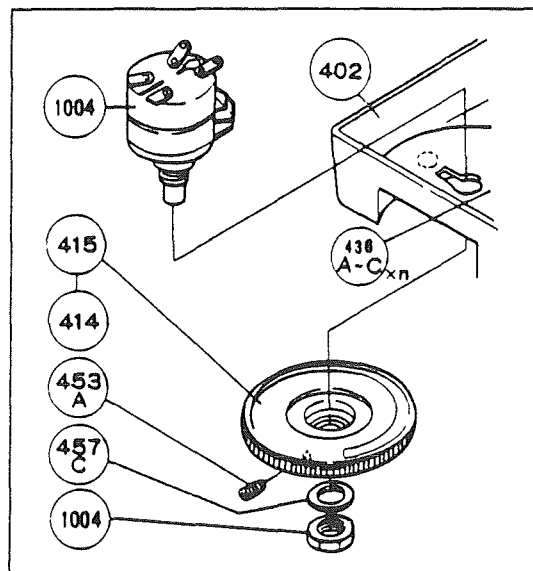


Fig. 34

## DISASSEMBLY PROCEDURE

## 4. Base Unit

< Removing mirror (G4) and mirror holder (404) >

- 10) After removing brightness indicator holder (only for OPTIPHOT), take off retaining ring (404). (Fig. 35).

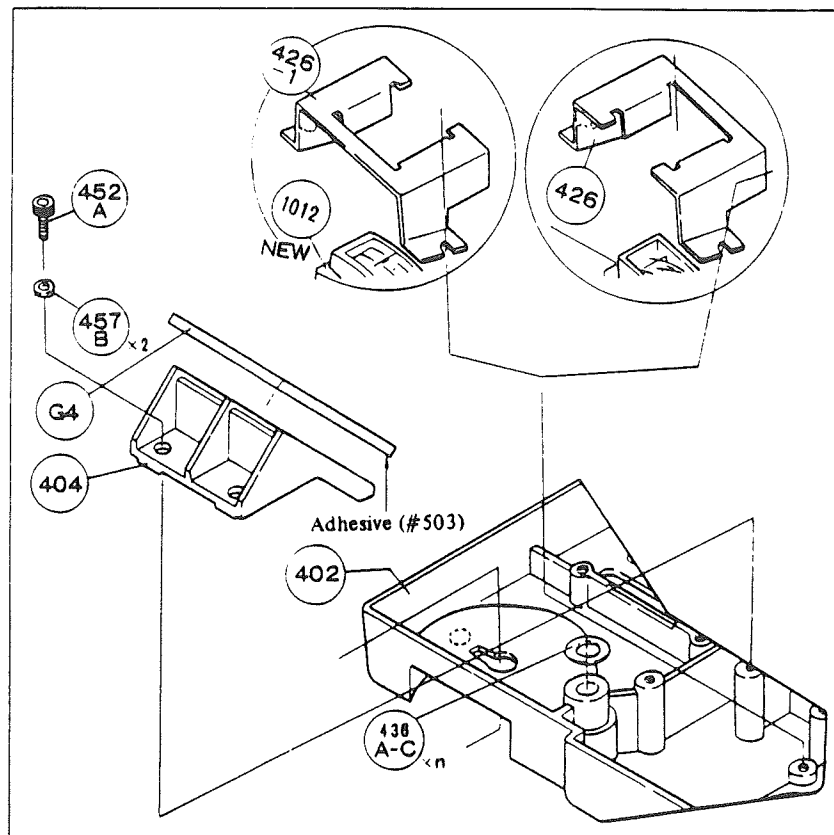


Fig. 35

- 11) Other parts can be disassembled in any sequence.

Note: Washers (436A ~ 436C)  $\times n$ , used for adjusting slack, when attaching the base to the main body, should be returned to their original positions.

## REASSEMBLY PROCEDURE

## 1. Coaxial Coarse and Fine Focus Knob Unit

## REASSEMBLY PROCEDURE

## 1. Coaxial Coarse and Fine Focus Knob Unit

- 1) Beforehand, clean (107), (109), (110), (123) ~ (128), (130), (131) using trichloroethylene.
- 2) Applying No. 616 to the thread of pinion shaft (109), screw it into spur gear (123).
- 3) Apply G7920 to (109) at the position indicated in Fig. 16, and insert the subassembly consisting of (109) and (123) into pinion case (105). Furthermore, attach pinion thrust receptacle (116) to (109). In this case, make sure of smooth rotation of (105) and (109).
- 4) Clean the thread of pinion case (105), using gasoline.  
After drying, apply No. 350, and screw in coarse focus bearing (106). (Fig. 36).

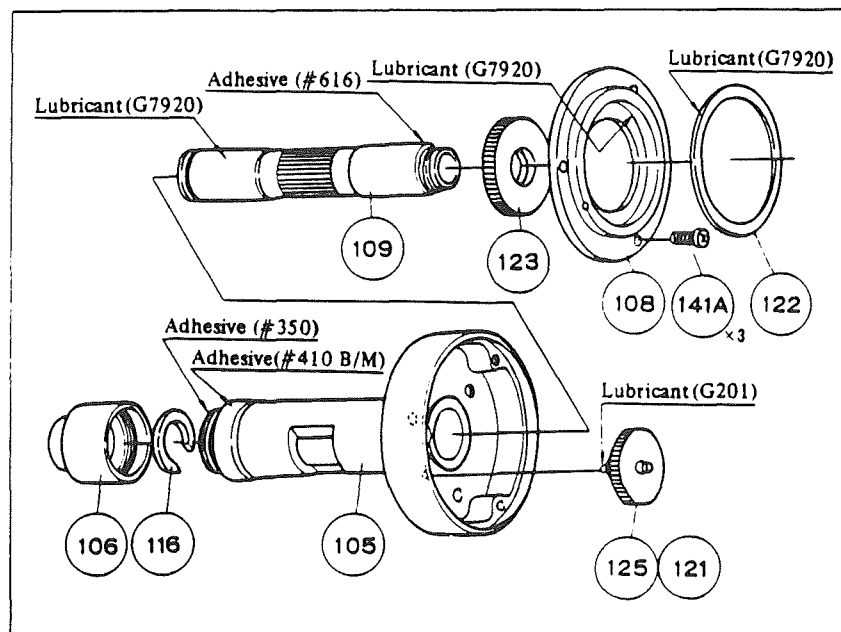


Fig. 36

- 5) Insert the above subassembly into the arm. (Fig. 37).
- 6) Inserting rack (9) from underneath the arm, attach it to the ball race by means of PM screw (41C) and CM screw (42A). (Fig. 38). After attaching, fix pinion case (105) to the arm by means of screws (41A) x3. (Fig. 37).

Note: (106) might be scratched or deformed by the use of a wrench, when detached, in this case, replace it.

## REASSEMBLY PROCEDURE

## 1. Coaxial Coarse and Fine Focus Knob Unit

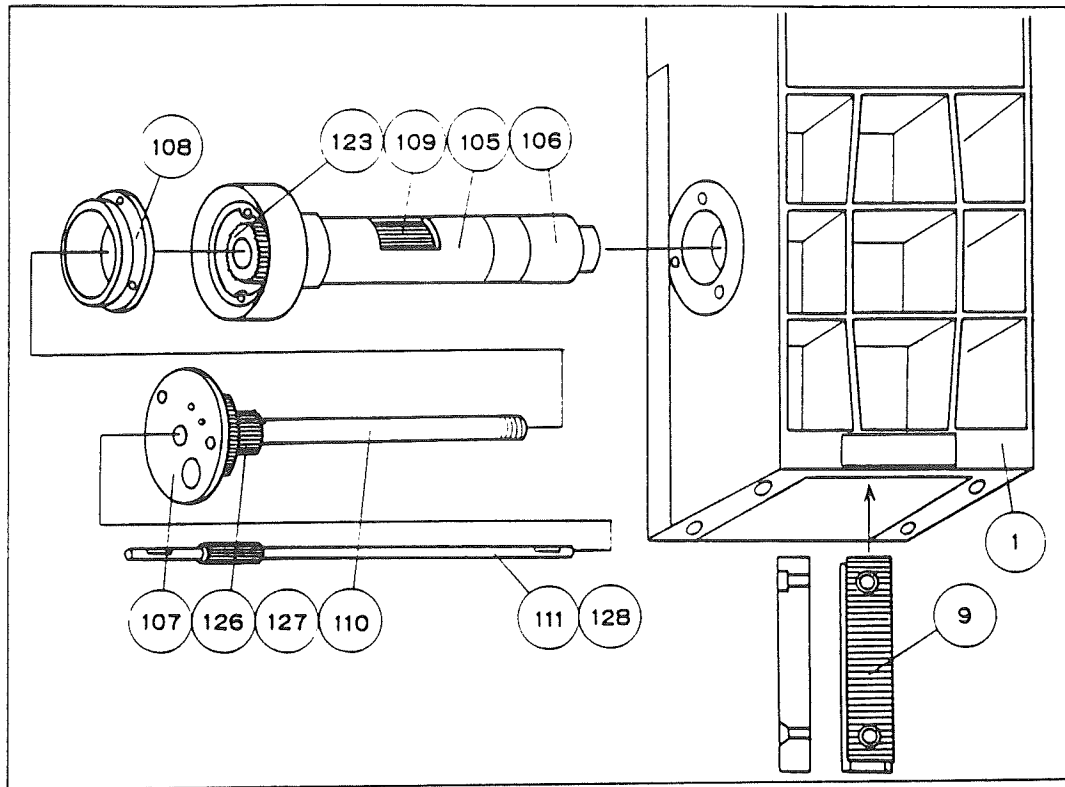


Fig. 37

- 7) Attach gears (121) and (125) to pinion case (105), and coarse focus knob bearing (108) (this should be cleaned, beforehand) to (105) by means of screws (141) x3. ((121) and (125) are to be oiled as shown in Fig. 36, after cleaned and dried.)
- 8) Insert the subassembly consisting of (107) (coarse focus case) and (110) (coarse focus shaft) and (126) and (127) (gears), as shown in Fig. 37 (apply oil to (110) as shown in Fig. 10).
- 9) Thereafter, following 4) ~ 1), reverse the disassembly procedure. (After cleaned and dried, fine focus shaft (111), gears (124) and (125), (130), (131) and (130A) and gears (124) and (125) should be oiled as shown in Fig. 24.  
Cover plate (117) is to be cemented by No. 616. Apply G7920 to plate spring (118) and washer (120).

## REASSEMBLY PROCEDURE

## 2. Substage Unit

## 2. Substage Unit

For reassembly, reverse the disassembly procedure, taking the cautions as below:

- 1) The positions to be oiled or cemented should be cleaned and dried, beforehand. Use only the specified lubricant and adhesive.
- 2) Rotation torque of the condenser focus knob (210) is to be adjusted to 450g ~ 500g, when the knob is turned with pinion (208) held by the hand. Make the adjustment by turning the pinion bearing (212).

(Measuring procedure: Fig. 38)

After adjustment, fix the knob with set screw (236).

- 3) If in Disassembly Process (5) (P. 24) both the dovetails have been removed simultaneously for an unavoidable reason, it will be necessary for finding the fiducial position to use the specified positioning tool.
- 4) Check for smooth movement of the sliding parts of the dovetails, without slack, unevenness or the like.

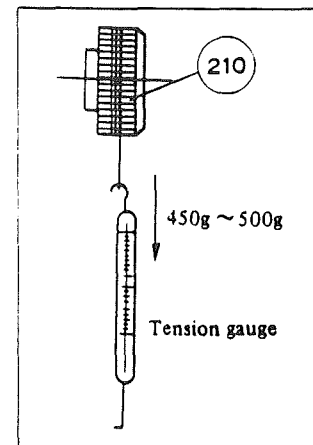


Fig. 38

- 5) Proceed to fitting of the rack as below:
  - i) Insert set screws (236) x2 into the main body of substage.
  - ii) Attach the knob to (201) with (236) x2, transitorily.
  - iii) Attach rack (207) to dovetail (male) (205) with (274) x2.
  - iv) After releasing (236) x2 and inserting the dovetail, turn pinion bearing (212), so that the gearing of rack (207) is achieved, and fix it in this position with (236A) x2 (utilizing the eccentricity of (212)).
  - v) Make sure of no clearance between (201) and (212) and smooth operation without slack, unevenness or the like.

## REASSEMBLY PROCEDURE

## 2. Substage Unit

- 6) To attach the condenser mount follow the procedure as below (Fig. 27):
- i) Attach spring retainer (214) to condenser receptacle (204) with screws (231A) x2.
  - ii) Insert plate spring (213) between (204) and (214). Bend the spring as shown by the arrow in Fig. 39.
  - iii) Apply G7910 to the sliding surface of condenser centering mount (203), and condenser receptacle (204).
  - iv) Insert (204) into (203).
  - v) Screw condenser clamp screw (215) into (204) through the opening of (203).
  - vi) See that no seizure occurs between (203) and (215), when manipulating right and left condenser centering screws (216) to bring (204) to the center, and (215) operates smoothly.

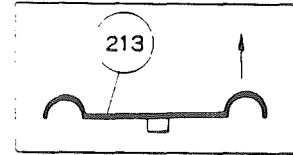


Fig. 39

### 3. Arm Unit (OPTIPHOT, LABOPHOT)

For reassembly, reverse the disassembly procedure, taking the cautions as below:

- 1) Clean and dry the parts to be oiled or cemented as shown in Fig. 29, 30, and then apply the specified lubricant and adhesive.
- 2) If in Disassembly Procedure 7 (P. 22) the lefthand race (8) on the fiducial side has been dismantled for an unavoidable reason, use the right one as fiducial (Assuming that both the right and left races have not been dismantled).

3) Proceed to adjustment of the roller races as below:

- i) Fix (10A) x4 to the guide rails (10A) attaching surfaces of (8), using lubricant G202. (Fig. 40).
- ii) Attach (10B) x4 to both the guide rail (10B) attaching surfaces of roller race (male) (7), using lubricant G202. (Fig. 40).

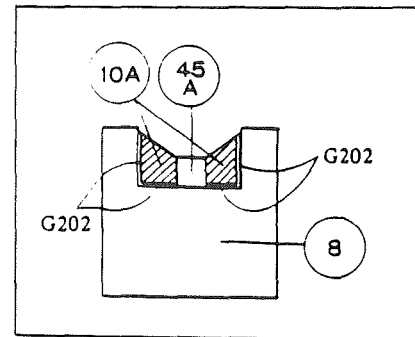


Fig. 40

- iii) Apply lubricant G202 to the sliding surfaces of (10A), (10B) and cylindrical rollers (11).
- iv) Place cylindrical rollers (11) and retainer (12) onto the surfaces of (10A). At this time, insert (11) one after another in turn. (Fig. 29).
- v) Assemble (7) and (8), transitorily.
- vi) As shown in Fig. 21, pushing (8), adjust the torque of (7) to 100g ~ 120g. Fix it in this position with (43A) x3.
- vii) Set it with (44A) x6, and inject cementing agent No. 350 into (44A) at six points.

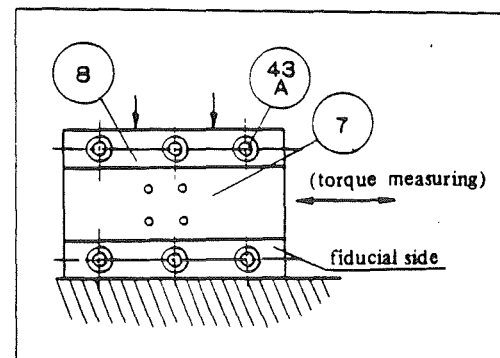


Fig. 41

**4. Base Unit**

For reassembly, reverse the disassembly procedure, remembering that the parts to be oiled or cemented (Fig. 32 ~ 35) are to be cleaned and dried, beforehand, and the specified lubricant or adhesive should be applied.



## ADJUSTMENT

1. Torque of Coarse Focus Knob  
2. Smooth Turning of the Left Fine Focus Knob

## ADJUSTMENT

## 1. Torque of Coarse Focus Knob

- 1) Referring to Reassembly Procedure (P. 32), insert wave washer (119) and adjusting washer (121) in sequence, as shown in Fig. 42, into coarse focus shaft (110). After screwing coarse focus knob (104) and bush (115) into (110), make adjustment of the torque to 400g ~ 500g, by means of washers (121A), (121G).

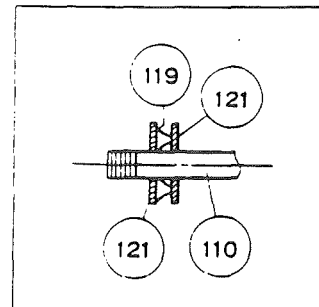


Fig. 42

- 2) When a correct torque is obtained, disassemble coarse focus knob (104) and bush (115).

Applying adhesive No. 410 to the thread, fix (104) and (115) in position. Be careful not to let the adhesive enter the internal surface of (110).

## 2. Smooth Turning of the Left Fine Focus Knob

- 1) Referring to Reassembly Procedure (P. 32), attach G7920 onto both sides of washer (120), and insert the washer into fine focus shaft (111). Then, insert left fine focus knob (102) into (111) (beforehand, place set screw (42A) into (102)), and set it with (142A) in such a position that the thrust slack of the knob is not felt by touching with the finger.

- 2) Make sure of seizure between coarse focus knobs (104) and (102), and their smooth turning.

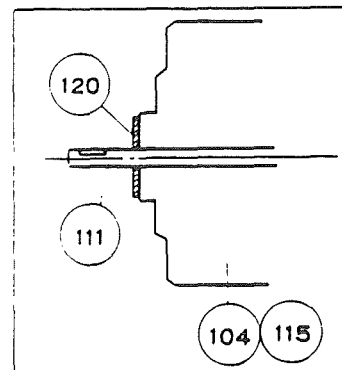


Fig. 43

## ADJUSTMENT

3. Smooth Turning of the Right Fine Focus Knob  
4. Parallelism between the Tube Attaching and Stage Attaching Surfaces

## 3. Smooth Turning of the Right Fine Focus Knob

- 1) Referring to Reassembly Procedure (P. 32), insert right fine focus knob (101) into fine focus shaft (111) (beforehand, place set screw (142A) into (101)). Pushing the left and right fine focus knobs inwards, fix them in such positions by means of (142A), that a torque of 30g ~ 40g is obtained. (Measuring procedure: Fig. 38).
- 2) Make sure of no thrust slack felt by touching with the finger and no seizure between (101) and right coarse focus knob (103). Also, check for smooth turning of the fine and coarse focus knobs.

## 4. Parallelism between the Tube Attaching and Stage Attaching Surfaces

For checking the parallelism, the top surface of tube receptacle (3) serves as fiducial.

- 1) Bringing the tool collimator onto the top surface of tube receptacle (3), check the parallelism using a mirror placed on the surfaces (1), (2) and (3) one after another, as shown in Fig. 44.

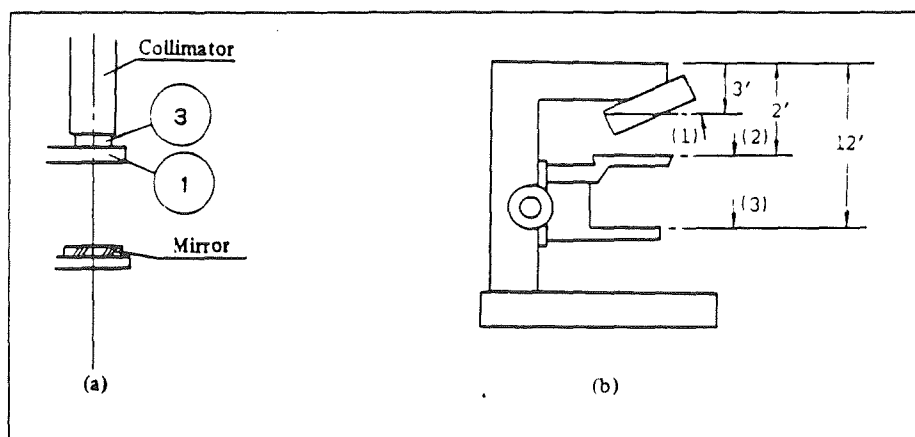


Fig. 44

- 2) The parallelism should be within the range as indicated in Fig. 44(b).
- 3) If this range is overrun, make the parallelism adjustment as follows:  
Viewing toward the front of the microscope, release screws (43A) x 4 (first, two of them, and if not sufficient, all the four), and swing the whole substage laterally for X-direction. Then for Y-direction, using adjusting washers (15A) ~ (15C) between (7) and (201), swing back and forth, until the parallelism comes within the S specified range.

## ADJUSTMENT

## 5. Centering the Tube Attaching and Stage Attaching Parts

## 5. Centering the Tube Attaching and Stage Attaching Parts

To perform the centering, use the three tools, as follows:

## 5-1. Using the tube receptacle substage centering tool J25142.

- 1) Place the part (B) of the tool, as shown in Fig. 2 (P. 3) on the tube receptacle (3). Set the part (A) onto the stage attaching surface of the substage. (Fig. 45)
- 2) Push the part (C) against the part (A) from above. If the former enters the latter, it proves correct centering.
- 3) If not, make adjustment, using the two upper screws of (43A) x4 behind the arm, so that the part (C) enters the part (A). Thereafter, make parallelism adjustment, using the lower two screws.
- 4) Smooth insertion of the part (C) into the part (A) ensures the parallelism within the range as shown in Fig. 44(b).

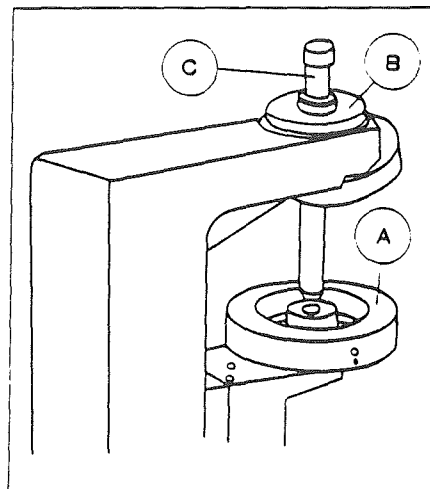


Fig. 45

## 5-2. Using substage rightangle/centering tool J25145 and J25143, to check the parallelism between the objective attaching and stage attaching surfaces.

- 1) Set tool J25145 onto the objective attaching surface to be checked. Place J25143 on the stage attaching surface.
- 2) Raise the substage to see that the clearance of J25145 is smaller than 1/100mm (in X and Y directions).
- 3) If it is found over 1/100mm, make the same adjustment as mentioned above in 4.3) (P. 39), until it comes within the specified range.

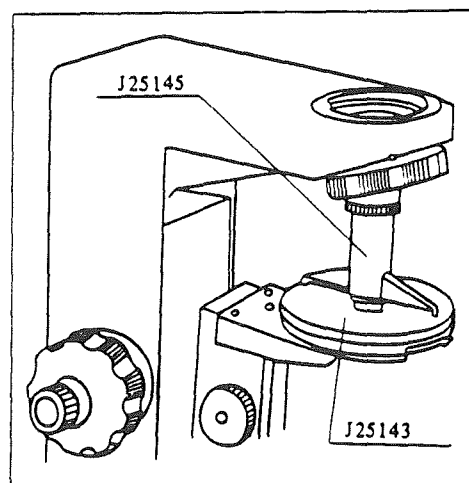


Fig. 46

## ADJUSTMENT

5. Centering the Tube Attaching and Stage Attaching Parts  
6. Centering of Optical System in the Microscope Base

5-3. Using positioning tool J25141, to check the position of substage and condenser mount

- 1) As shown in Fig. 1 (P. 3), bring the part (A) of the tool onto the condenser attaching surface, and the part (B) onto the stage attaching surface.
- 2) Raise the condenser attaching surface to make sure that the part (B) enters the part (A).
- 3) If it does not, make adjustment by means of (234A) x4.

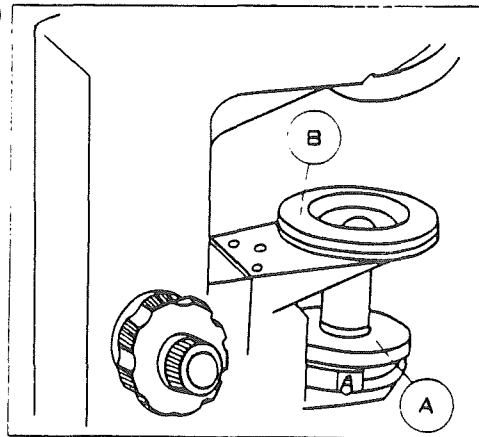


Fig. 47

## 6. Centering of Optical System in the Microscope Base

6-1. Using tools J25146 (for OPTIPHOT)

- 1) Take off the lamp housing, and set the tool J25146. (Fig. 48).
- 2) Set the above cited collimators on the specified positions on the base.  
Eliminate any slack, if takes place, by means of washers.
- 3) Bringing the part (A) (Fig. 6) onto the position without the lens, make sure of the correct positions of the filament ((a)) and mirror ((b)), viewing through the eyepiece of collimator. (Fig. 49).
- 4) If the positions are not found coincided, make adjustment by means of screws (452A) x2, provided for attaching mirror mount (404). (Fig. 32).
- 5) Place the part (A) onto the position with the lens.  
Viewing the position of the field diaphragm through the eyepiece, bring the diaphragm to the center by means of screws (451B) x2 provided for attaching blade mount (406).

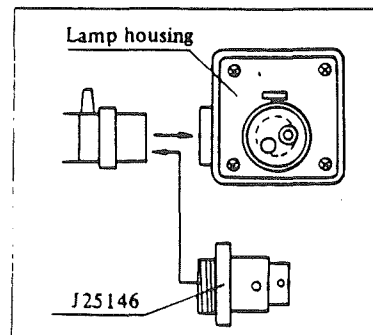


Fig. 48

## ADJUSTMENT

## 6. Centering of Optical System in the Microscope Base

- 6) If the field diaphragm does not come to the center, incorrect positioning of the mirror or filament is conceivable.

In this case, correct their positions, and proceed to 3) and 6) again.

- 7) Check the minimum (less than  $1\text{mm}^\phi$ ) and maximum (more than  $35.9\text{mm}^\phi$ ) diameters of the field diaphragm.

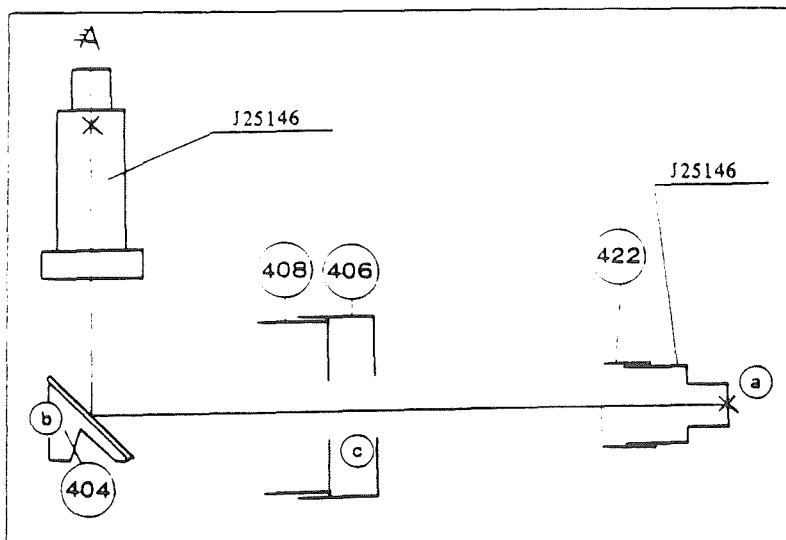


Fig. 49

## 6-2. Using tools J25147 (for LABOPHOT)

- 1) Take off (427), (429), (G2), (G3), and set the tool J25147. (Fig. 49).
- 2) Refer to 2) ~ 7) of 6-1. (P. 41).

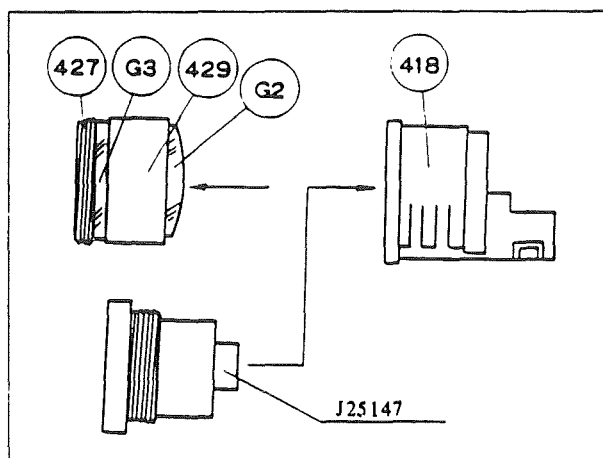


Fig. 50

**7. Tube Length**

- 1) Attach the part (A) of tool J25148 (Fig. 8) (P. 5) to the tube attaching part, the part (B) to the nosepiece, and the part (C) to the stage attaching surface, respectively.
- 2) Attach the trinocular eyepiece tube to the part (A).  
Using the 20X eyepiece, see the interference colors in the grating of the part (C).
- 3) In this case, the colors should be the same as those viewed through the vertical tube.  
If not, rotate cover ring (107) (beforehand, dissolve No. 350 by alcohol) of the tube, until the same colors are attained. Cement (107) again, using No. 350.

## 8. Adjustment of Brightness Control Circuit (Fig. 51, 52)

- 1) Turn off the power switch  $S_1$  (1004).
- 2) Fully turn (⊖) the shaft of variable resistor  $VR_3$  in the DC ammeter  $M_1$  (1002), counterclockwise.
- 3) Fully turn (⊖) the shaft of variable resistor  $VR_1$  (1101) in the printed circuit counterclockwise.
- 4) Change over the power change-over switch  $S_2$  (1005) to AC 100V.
- 5) Set the power voltage to AC 100V  $\pm$  1%, 5 Hz.
- 6) Connect the thermostat-type voltmeter (over 1.5 class) for measuring the lamp voltage to the terminal of the lamp.
- 7) Plug the power source cord into the socket.  
After connecting the halogen lamp of 12V, 50W with the lamp socket.
- 8) Turn on the power switch  $S_1$  (1004).  
Do not turn the power switch dial beyond the position where the switch is just turned ON (at a maximum voltage of variable resistor  $VR_2$  (1004)).  
In this position the brightest illumination will be obtained.
- 9) Slowly turn the shaft of variable resistor  $VR_1$  (1101) in the printed circuit, clockwise, and then the illumination of the lamp will be slowly darkened.  
Stop this turning at the position where the lamp filament looks dim.  
Do not turn the shaft beyond this limit, because the lamp will glow suddenly.
- 10) Turn the dial of power switch  $S_1$  (1004) in the direction in which the voltage of variable resistor  $VR_2$  (1004) becomes lower, until the thermostat-type voltmeter indicates 9.0V.
- 11) Turn the shaft of variable resistor  $VR_3$  (1010) for sensitivity adjustment, clockwise, so that the DC ammeter  $M_1$  (1012) indicates 9.0V.

**ADJUSTMENT****8. Adjustment of Brightness Control Circuit**

- 12) Turn the dial of power switch  $S_1$  (1004) to make the indication of DC ammeter  $M_1$  (1012) minimum.  
In this case, the voltage of variable resistor  $VR_2$  (1004) will be maximum.
- 13) If the DC ammeter  $M_1$  (1012) indicates a value not higher than 1.8, turn the shaft of variable resistor  $VR$  (1101) in the printed circuit, counterclockwise, and if it indicates a higher value than 2.5, slowly turn the shaft clockwise, until the meter indicates a value within the range 1.8 ~ 2.5V.
- 14) Fully turn the dial of power switch  $S_1$  (1004) to make sure that the brightness of the lamp and swing of the needle in the DC ammeter  $M_1$  (1012) changes smoothly over 11.5.



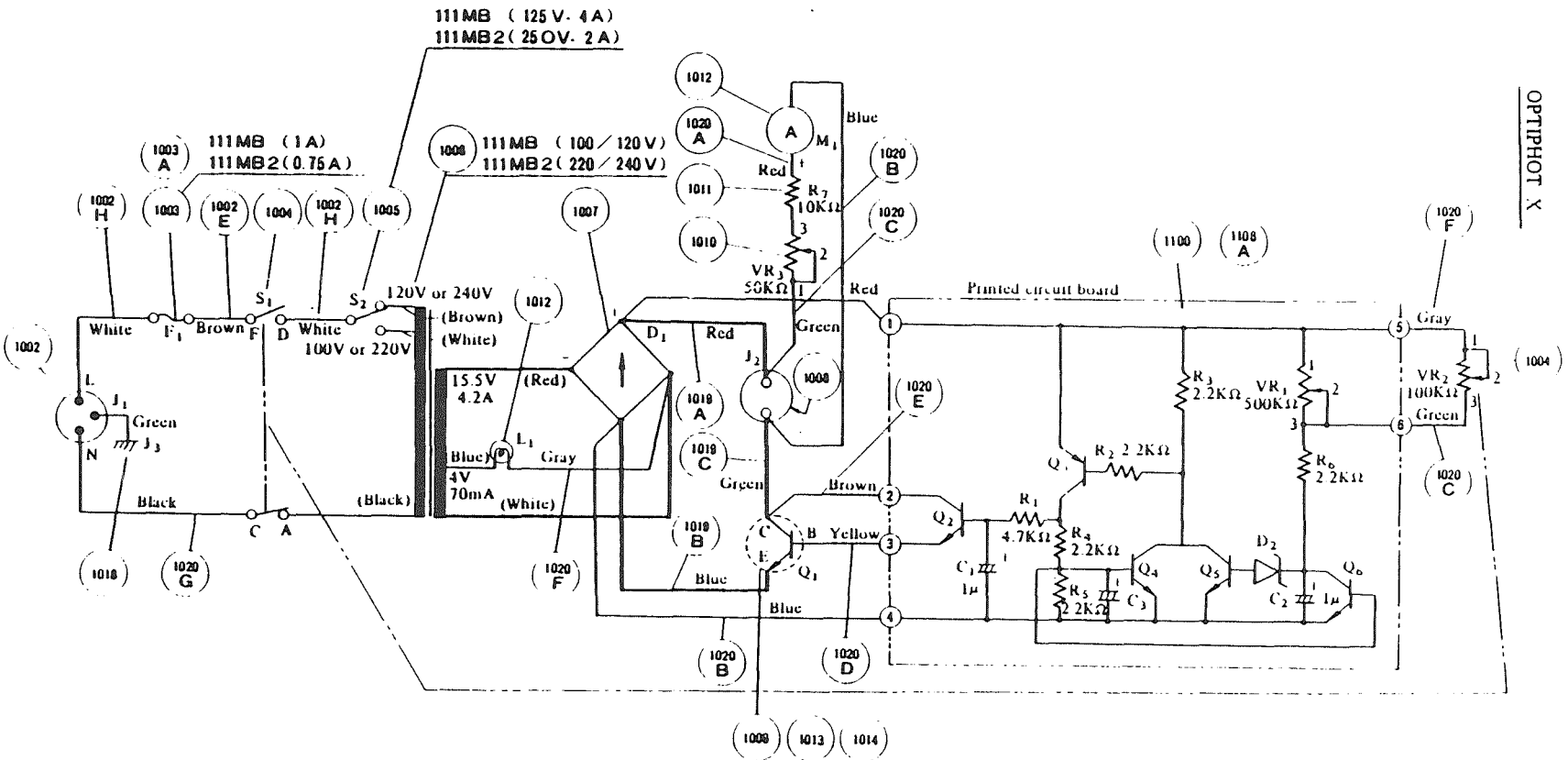
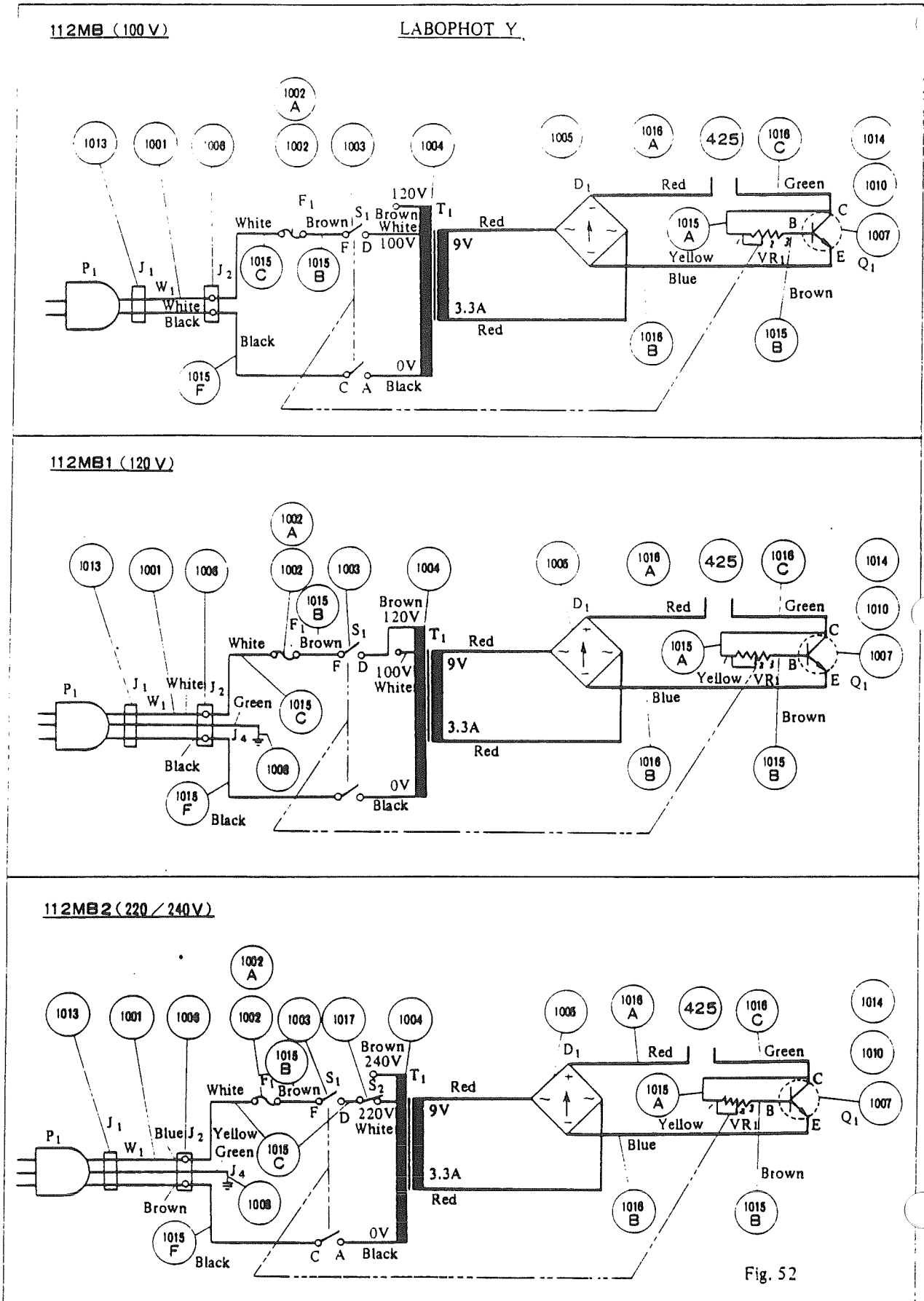


Fig. 51

ADJUSTMENT

8. Adjustment of Brightness Control Circuit



## TOOLS AND PREPARATIONS

## 1. Tools for General Use 2. Exclusive Tools

## TOOLS AND PREPARATIONS

## 1. Tools for General Use

Item	Used for
4 + screwdriver set	Screwing in general
6 - screwdriver set	"
Tweezers (Stainless steel)	
Blower	Cleaning
Handlap	Containing absolute alcohol.
Hexagonal spanner	Hexagonal socket head bolts (3, 4, 5, 6mm), Set screws (3, 4mm)
+ Screwdriver with wood handle	3 and 2.6mm screws (conical point and oval point)
Plastic hammer	Giving sharp knock

## 2. Exclusive Tools

Item	Tool No.	Used for
15mm grating micrometer	J28004	Checking perpendicularity, straightness of movement
Microscopes stand with 10X 40X objectives		Adjustment in general
Kellner eyepiece	J28006	
Tension gage		Measuring torque
Box screwdriver	J21060	Hexagonal nuts (4mm) (55A)
Torque adjusting tool	J21061	Round nuts (15) (16) (Fig. 1)

- Torque adjusting tool

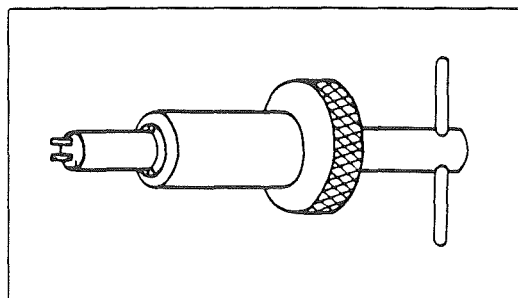


Fig. 1

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**TOOLS AND PREPARATIONS**
**3. Lubricant 4. Adhesive 5. Others**


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**3. Lubricant**

Item	Used for
G6053	Stage base plate (2) and clamp screw (42).
G7910	Pinion bearing (10) and X pinion (11), Y pinion (12). Wave washer (17) and Delrin washer (19). Wave washer (18) and Delrin washer (21).
G7866	Spiral spring (36)

**4. Adhesive**

Item	Used for
#410 N/L	Stage upper plate (1), stopper (26) and screw (52e), Pinion cover (9) and pinion bearing (10), Y pinion (12) and Y axle (screw).

**5. Others**

- Absolute alcohol (ethanol or methanol)
- Lens tissue

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**DISASSEMBLING PROCEDURE**


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**DISASSEMBLING PROCEDURE**

- 1) Detach the slide holder assembly from the stage releasing the fixing screws 39 x 2.
- 2) Releasing the screws (51A) x 2 remove the holder metal (34) from the holder (32).
- 3) Removing the screws (53A) separate the slide glass retainer (33) together with the washer (37) and the spiral spring (36) from the holder metal (34). (Fig. 2)

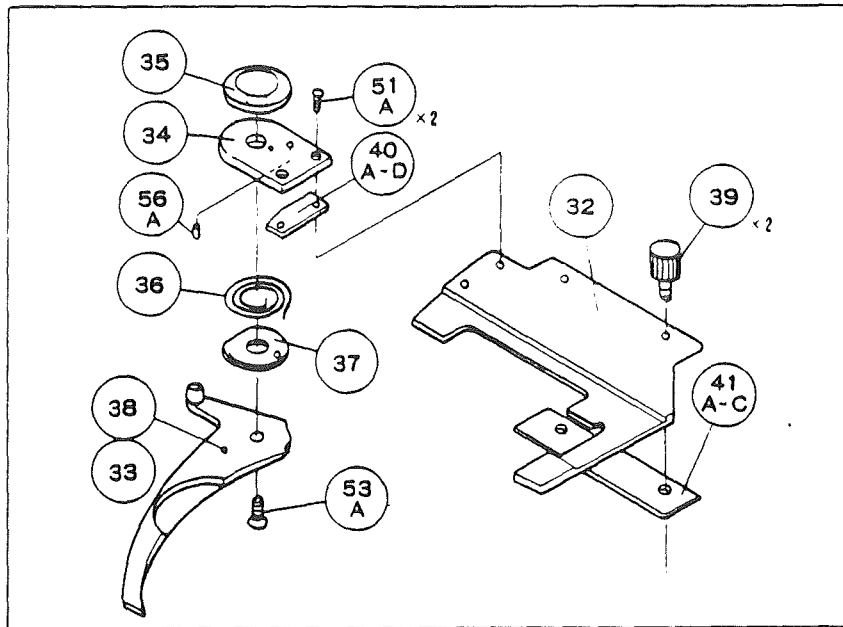


Fig. 2

- 4) Releasing the screws (54C) x 2, remove the rack (22) (Fig. 4).
- 5) Removing the screws (54A) x 2 of the pinion cover (9) separate the handle assembly from the stage.
- 6) Remove the nut (55A) of the X (right and left) knob (14).
- 7) Remove the X knob (14).
- 8) Remove the wave washer (18), the Delrin washer (21) and the flat washer (58C).
- 9) Remove the round nuts (15) (16) of the Y (to and fro) knob (13).
- 10) Remove the wave washer (17) and the Delrin washer (19).
- 11) Remove the Y pinion (12) and Y knob (13) assembly.

## DISASSEMBLING PROCEDURE

- 12) Remove the Delrin washer (20).
- 13) Remove the X pinion (11A)(11B) together with the Delrin washer (21). (Fig. 3)

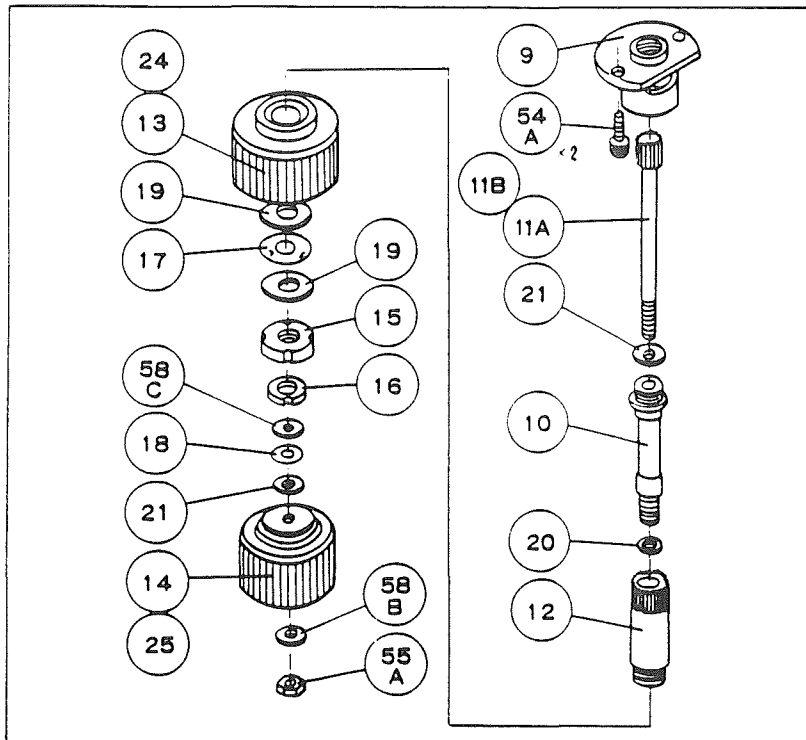


Fig. 3

- 14) Releasing the screws (52A) x 2, separate the vernier scale seat (27) from the stage base plate (2). (Fig. 4)
- 15) Releasing the screws (54B) x 4 separate the X guide block (4) from the Y guide blocks (3A), (3B). At the same time the X block (5), the rollers (6) the retainers (7) and the guide rails (8B)(8C) are also separated.
- 16) Remove the X rack (23) from the X block (5).
- 17) Separate the guide block either (3A) or (3B) from the stage upper plate (1). Then the stage base plate (2) the rollers (6), the retainers (7) and the guide rails (8A) becomes free. (Fig. 5)

DISASSEMBLING PROCEDURE

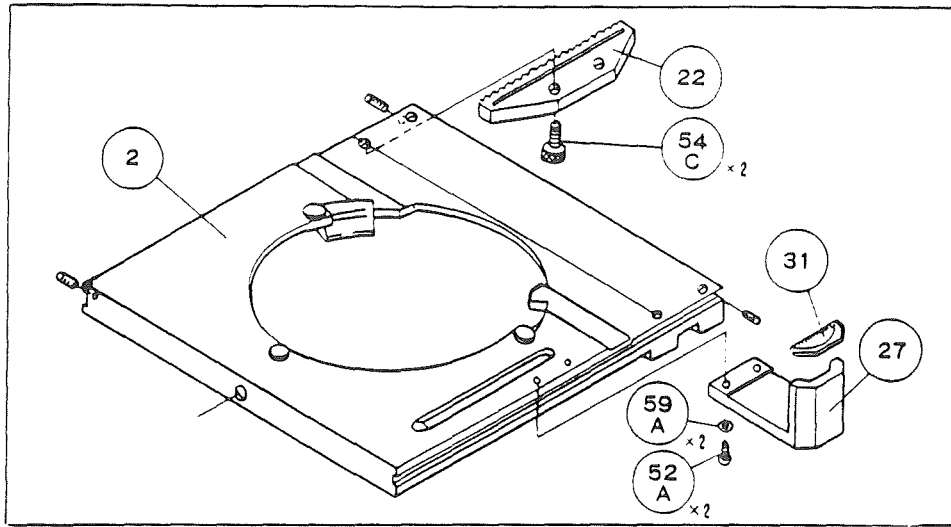


Fig. 4

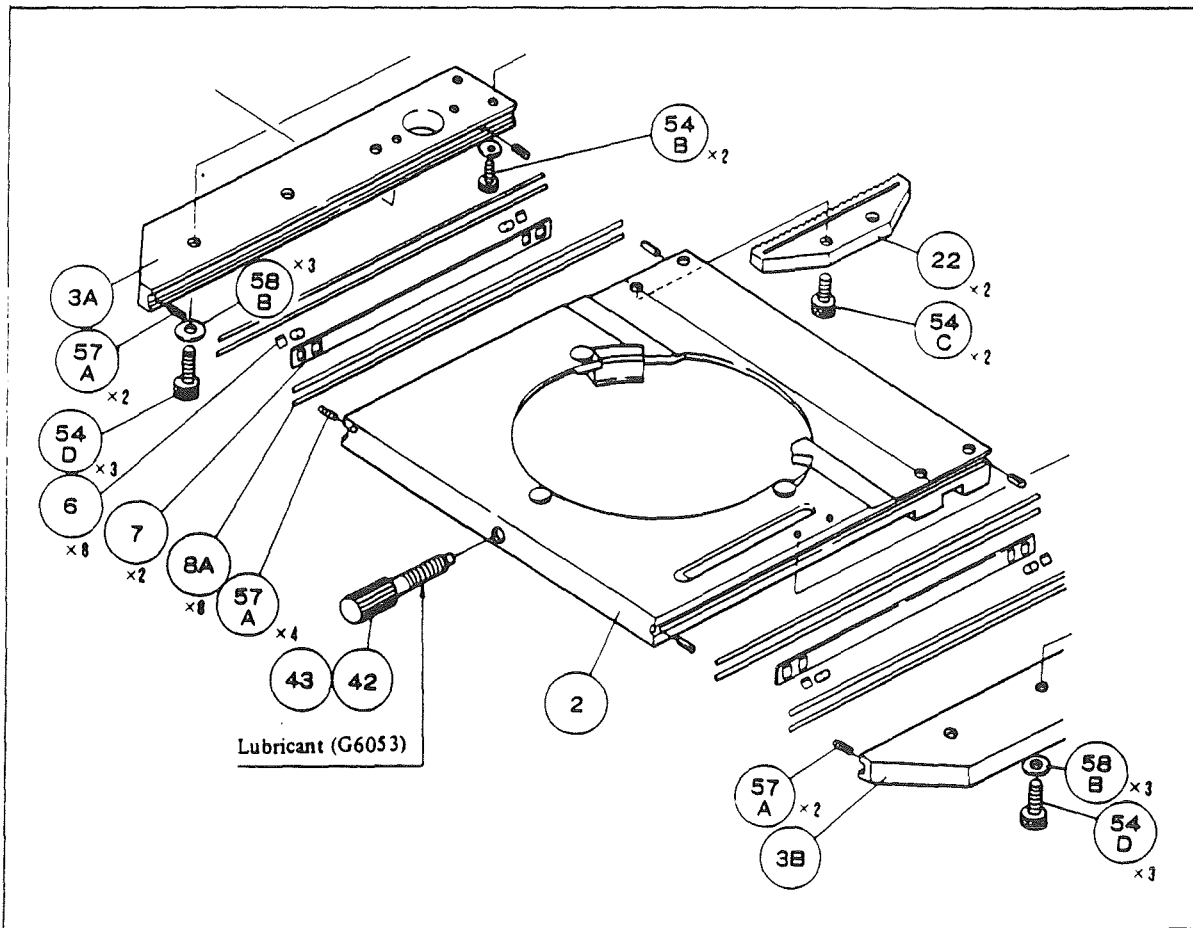


Fig. 5

DISASSEMBLING PROCEDURE

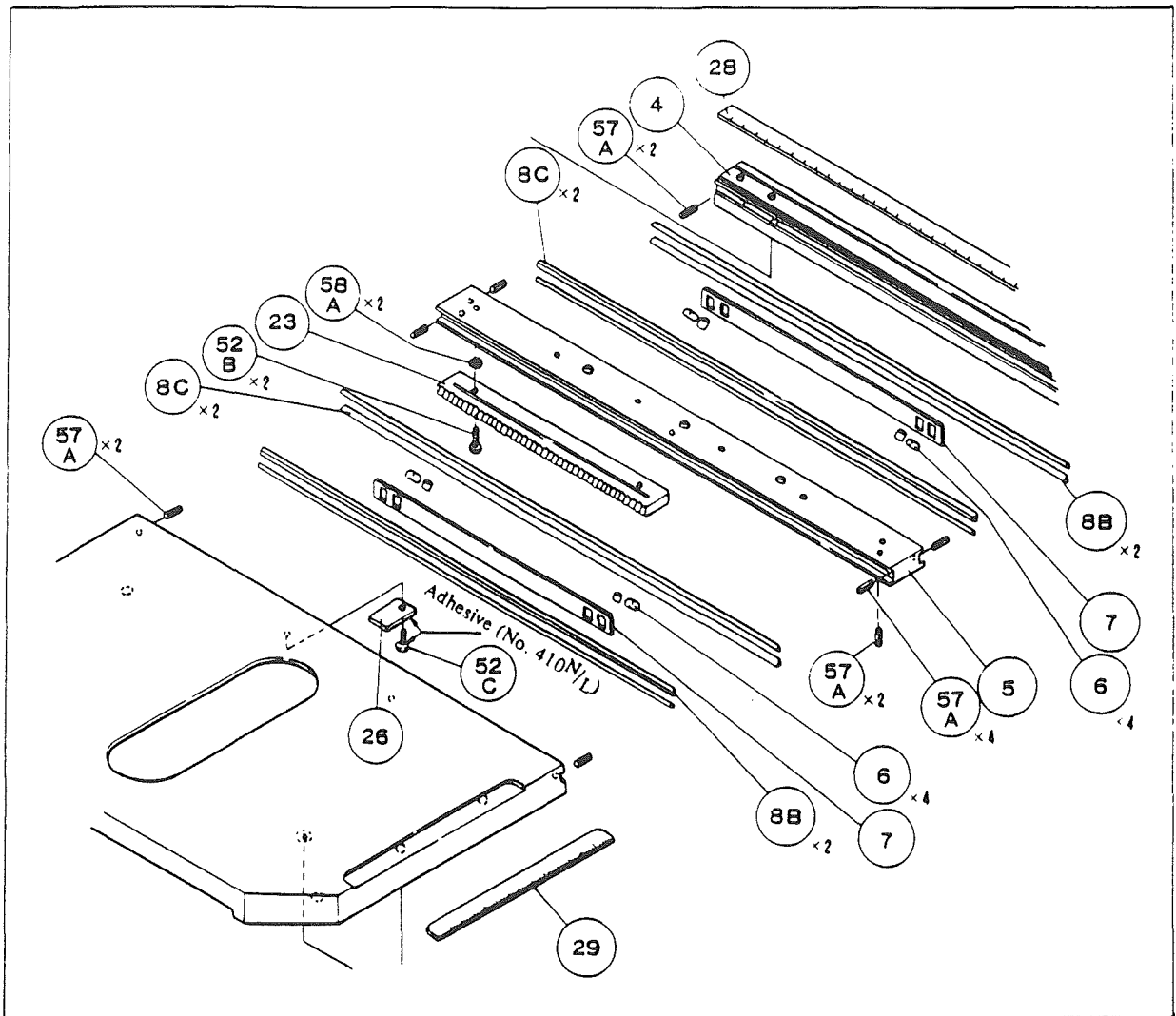


Fig. 6



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**REASSEMBLING PROCEDURE**


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**REASSEMBLING PROCEDURE**

## &lt; Reassembling the Slide Holder &gt;

- 1) Put the axle supporter (35) on the slide holder metal (34). Place the spiral spring (36) on the metal (34) inserting its inner end into the pin hole of the metal (34).
- 2) Insert the outer end of the spiral spring (36) through the pin hole of the washer (37).

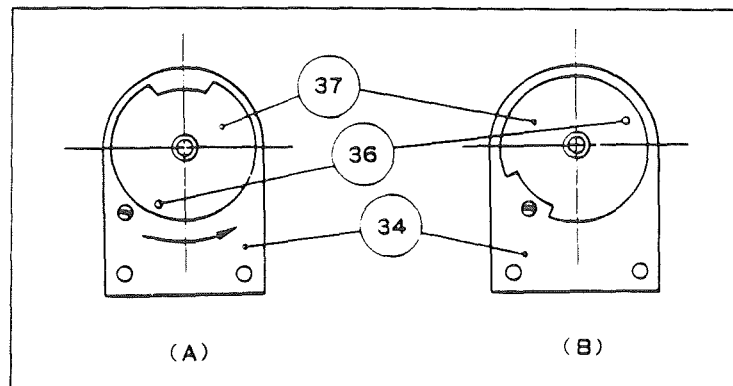


Fig. 7

- 3) Keeping the spiral spring, the inner end in the pin hole, turn the washer (37) in the arrow direction (A) and to be positioned as shown by (B) in Fig. 7.

Then, place the slide glass retainer (33) over the washer (37) inserting the spiral spring outer end into the pin hole of the retainer (33) and fasten the screw (53A). (Fig. 8)

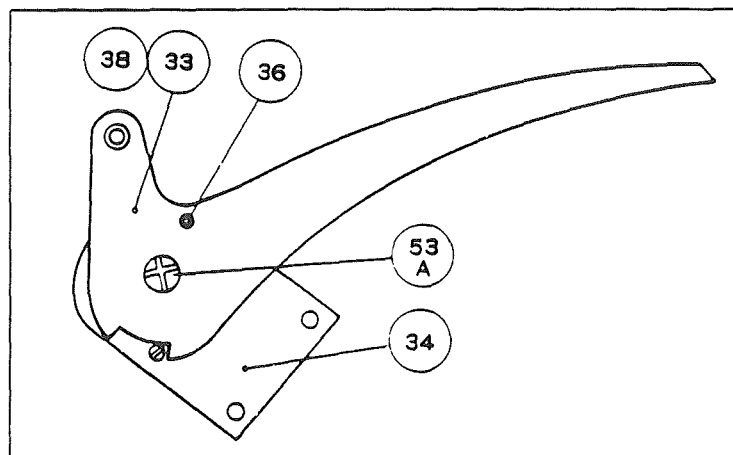


Fig. 8

- 4) Fix the above slide glass retainer assembly on the holder (32). The latter is to be attached to the stage.

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**REASSEMBLING PROCEDURE**


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**< Reassembling the Handle >** (Fig. 9)

- 1) Insert the X pinion with the axle (11A)(11B) into the assembly of the pinion cover (9) and the pinion bearing (10).  
Placing the washer (21) in between.  
Lubricate (11A)(11B) with the oil G7910 and (10) with the oil G7920.
- 2) Fit the assembly of the Y pinion (12) and the Y knob (13) to the bearing (10) inserting the washer (20).
- 3) Put the Delrin washer (19) x1, the wave washer (17) and the flat washer (19) x1 on the bearing (10) in following order: (19) → (17) → (19).
- 4) Screw on the round nut (15) and the lock nut (16) to the bearing (10) to hold the Y knob on the bearing. The turning torque of the Y knob is to be adjusted by means of these nuts.
- 5) Put the flat washer (58C), the wave washer (18) and the Delrin washer (21) on the axle (11A) in the following order: (58C) → (21) → (18).
- 6) Screw on the X knob (14) to the axle (11A).
- 7) Put the washer (58B) and screw on the nut (55A) to the axle (11A).  
The turning torque of the X-knob is to be adjusted by means of the nut (55A).

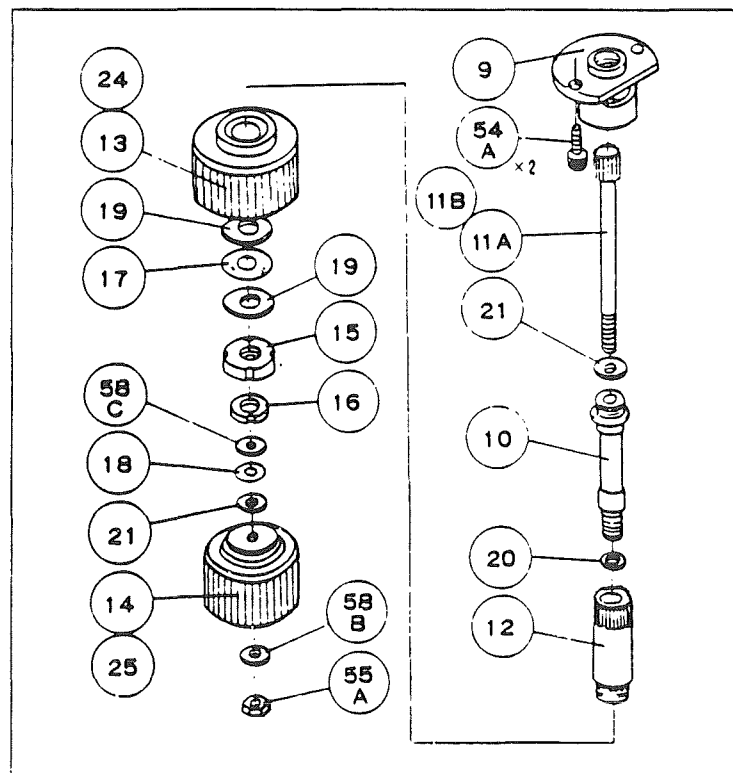


Fig. 9

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**REASSEMBLING PROCEDURE**


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**< Reassembling the X and Y Movement >** (Fig. 5, 6) .

- 1) Place the stage upper plate (1) upside down tilting on a table. The guide block (3A) (or (3B)) whichever that has been left fixed on (1) makes the basis of the reassembling.  
Place the rails (8A) x2 → the rollers (6) x4 → the retainer (7) x1 lubricating with lubricant G202 on the groove of the guide block (3A) .
- 2) Place the stage baseplate (2) on (1) facing its rail groove to the rail groove of (3A) . Put the rails, rollers and retainer (8A) x2 → (6) x4 → (7) x1 on the other rail groove of (1) applying G202 oil.  
Place the guide block (3B) ( (3A) ) on (1) facing its rail groove to the rail groove of (2) . Fix the guide block (3B) to the upper plate (1) by screwing the screws (54D) x3 .
- 3) Make sure that no slack in the X direction is found at the both end of the moving range of the upper plate (1) on the base plate (2) .  
If any slack is found, release slightly the screws (54D) x3 to adjust the guide block (3B) (or (3A) ) that has been just reassembled by the procedure 2) .
- 4) Place the whole stage assembly tilting on the work table so as the X rail groove of (1) is on the upperside.  
Put (8B) x2 → (6) x4 → (7) x1 on the above groove applying G202 oil.
- 5) Apply G202 oil to the both rail grooves of (5) on which put (8C) x4, then place (5) on (1) so as one rail groove of (5) faces to the groove of (1) .  
Put (6) x4 → (7) x1 on the other rail groove of (5) .
- 6) Put (8B) x2 on (4) rail groove applying G202 oil and place the latter to face the groove of (5) .  
Then, fix (4) to (3A) , (3B) screwing the screws (53B) x4 .
- 7) Fix the vernier scale (31) and its seat (27) to the stage base (2) by the screws (52A) x2 .
- 8) Fix the handle assembly to the guide block (3A) or (3B) and adjust the meshing of the pinion and the X rack (23) releasing the screws (54A) x2 slightly .

---

**REASSEMBLING PROCEDURE**

---

- 9) Place the Y rack (22) on the stage base (2) and adjust the meshing with the handle assembly releasing the screws (54C) x2 .
- 10) Attach the slide holder assembly to the stage.

**REPAIR AND ADJUSTMENT**

1. Failure of the Slide Glass Retainer 2. Slack of the Slide Glass Carrier  
3. Wobbling of the Slide Glass Retainer and the Slide Glass Carrier

**REPAIR AND ADJUSTMENT****1. Failure of the Slide Glass Retainer**

Cause: (1) The yielded or disengaged spiral spring (36).  
(2) Looseness of the small flat head screw (53A).

**< Repair and Adjustment >**

- (1) Exchange the yielded spiral spring (36) or hook the disengaged spring to the pin hole.

**Procedure**

- i) Disassemble the retainer assembly following the procedure 2), 3) (P. 5).
  - ii) If the spring is yielded replace it with a spare, and if the spring is disengaged, reposition it correctly following the reassembling procedure (P. 7).
  - iii) Check the function of repaired retainer.
- (2) If the small flat head screw (53A) is loosened fasten it firm and check the retainer function.

**2. Slack of the Slide Glass Carrier**

Cause: Looseness of the screws (39)

**< Repair and Adjustment >**

Fasten firm the screws (39). Make sure that no slack is found.

**3. Wobbling of the Slide Glass Retainer and the Slide Glass Carrier.**

Wobbling in X direction: Refer to the following chapter 4.

Wobbling in Y direction: Refer to the following chapter 5.

## 4. Wobbling in X (right and left) Movement

Cause: (1) Slack, sticking, squeezing in the X guide rail assembly.

- a) Inferior meshing of the rack (23) and the pinion (11A).
  - b) Dent on the X guide rails (8B), (8C), the rollers (6) or deformed retainers (7).
  - c) Dust, soil, scratch on teeth of the rack (23) or the pinion (11A).
- (2) Looseness of the screws (54B) or inferior adjustment of the X guide block (4).

## &lt; Repair and Adjustment &gt;

- (1)-a) If the rack (23) and pinion (11A) meshing is inferior adjust the position of the rack and pinion.

Procedure
-----------

- i) Detach the slide holder assembly from the stage.
- ii) Releasing the screws (54B) x 4 separate the X guide block (4) from the Y guide blocks (3A), (3B).  
Then, the X movement block (5), the rollers (6), the retainers (7) and the guide rails (8B), (8C) will be made free simultaneously.
- iii) The rack (23) position is to be adjusted slightly releasing the screws (52B) x 2.
- iv) The pinion (11A) position is to be adjusted slightly releasing the screws (54A) x 2.
- v) Follow the reassembling procedure.
- vi) Check the rack and pinion meshing and the wobbling in the X movement.

## REPAIR AND ADJUSTMENT

## 4. Wobbling in X (right and left) Movement

- (1)-b) If any dent is found on the guide rails (8B), (8C), the rollers (6) or if the retainer (7) is deformed, replace them with spares.

Procedure
-----------

- i) Follow the procedure i), ii) of (1)-a).
  - ii) Replace dented or deformed parts with spares.
  - iii) Follow the reassembling procedure.
  - iv) Check wobbling in the X movement.
- (1)-c) Dust or soil on teeth of the rack (23) and pinion (11A) are to be removed by a brush or cleaned by gasoline.
- If they are injured, replace them with spares.

Procedure
-----------

- i) Follow the procedure i) of (1)-a).
- ii) Remove the rack (22) releasing the screws (54C) x2.
- iii) Remove the handle assembly releasing the screws (54A) x2 of the pinion cover (9).
- iv) Follow the procedure ii) of the above (1)-a).
- v) Follow the disassembling procedure 6)-13) (P. 4).
- vi) Remove dust and soil by a brush or clean by gasoline. Replace injured parts with spares.
- vii) Follow the reassembling procedure.
- viii) Check wobbling in the X movement.

**REPAIR AND ADJUSTMENT**

4. Wobbling in X (right and left) Movement  
 5. Wobbling in Y (to and fro) Movement

- (2) Loosened screws (54B) are to be tightened firm and inferior position of (4) is to be readjusted.

**Procedure**

Slightly releasing the screws (54B) x2 adjust the (4) position and check wobbling in the X movement.

**5. Wobbling in Y (to and fro) Movement**

Cause: (1) Slack, sticking, squeezing in the Y guide rail assembly.

- a) Inferior meshing of the rack (22) and the pinion (12).
  - b) Dent on the Y guide rails (8A), the rollers (6) or deformed retainers (7).
  - c) Dust, soil or scratch on teeth of the rack (23) or the pinion (12).
- (2) Looseness of the screws (54D) or inferior adjustment of the Y guide block (3A) (or (3B)).

**< Repair and Adjustment >**

- (1)-a) If the rack (22) and pinion (12) meshing is inferior adjust their position.

**Procedure**

- i) The rack (22) position is to be adjusted slightly releasing the screws (54C) x2.
- ii) Check wobbling in the Y movement.



- (1)-b) If any dent is found on the guide rail (8A), the rollers (6) or if the retainer (7) is deformed replace them with spares.

**Procedure**

- i) Detach the slide holder assembly from the stage releasing the screws (39) x 2.
- ii) Remove the rack (22) releasing the screws (54C) x 2.
- iii) Remove the handle assembly releasing the screws (54A) x 2 of the pinion cover (9).
- iv) Releasing the screws (54B) x 4 separate the X guide block (4) from the Y guide blocks (3A), (3B). Then, the X movement block (5), the rollers (6) and the retainers (8B), (8C) will be made free.
- v) Releasing the screws (58B) x 3, remove either (3A) or 3B from (1) leaving another one fixed on (1) to make the basis for the reassembling. Then, the base plate (2), the rollers (6) and the retainers (7) become free.
- vi) If any dent is found on the Y guide rails (8A), the rollers (6) or if the retainer (7) is found deformed replace them with spares.
- vii) Follow the reassembling procedure.
- viii) Check wobbling in the Y movement.

## 6. Failure of the X (right and left) Handle Function

(Improper torque to turn the X knob due to inferior fitting of the bush (25))

- Cause: (1) Looseness of the nut (55A).  
 (2) The worn Delrin washers (21) on the knob (14) side and the pinion side (11A),  
 the worn or deformed wave washer (18) and the flat washer (58C).

## &lt; Repair and Adjustment &gt;

- (1) The loosened nut (55A) is to be fastened.  
 Then, check the X knob torque (or fitting of the bush (25)).
- (2) The worn Delrin washers (21) are to be replaced with spares. The same for the worn or deformed wave washer (18) and the flat washer (58C).

Procedure
-----------

(For the Delrin washer (21), wave washer (18) and flat washer (58C) on the handle (14) side)

- i) Follow the disassembling procedure of the stage 4) ~ 8) (P. 4).
- ii) Exchange the worn washer (21) and follow the reassembling procedure of the handle (P. 8).
- iii) Check the torque to turn the X knob (14).

Procedure
-----------

(For the Delrin washer (11A) on the pinion (11A) side)

- i) Follow the disassembling procedure 4) ~ 13) (P. 4).
- ii) Exchange the worn washer (21) and follow the reassembling procedure of the handle (P. 8).
- iii) Check the torque to turn the X knob (14).

**REPAIR AND ADJUSTMENT****7. Failure of the Y (to and fro) Handle Function  
8. Slack of the Handle Assembly****7. Failure of the Y (to and fro) Handle Function**

(Improper torque to turn the Y knob due to inferior fitting of the bush (24)).

- Cause: (1) Looseness of the nuts (15), (16).  
(2) The weared Delrin washer (19) or (20), or the wave washer (17).

**< Repair and Adjustment >**

- (1) The loosened nuts (15), (16) are to be fastened firm.  
Then, check the Y knob (13) torque (or fitting of the bush (24)).
- (2) The weared Delrin washer (19), (20) or the wave washer (17) are to be replaced with spares.

**Procedure**

(For the Delrin washer (19), wave washer (17))

- i) Follow the disassembling procedure 4) ~ 10) (P. 4).
- ii) Exchange the weared Delrin washer (19) or the wave washer (17).
- iii) Follow the reassembling procedure (P. 8).
- iv) Check the torque to turn the Y knob (13) (or fitting of the bush (24)).

**Procedure**

(For the Delrin washer (20))

- i) Follow the disassembling procedure of the stage 4) ~ 12) (P. 4).
- ii) Exchange the weared Delrin washer (20).
- iii) Follow the reassembling procedure (P. 8).
- iv) Check the torque to turn the Y knob (13) (or fitting of the bush (24)).

**8. Slack of the Handle Assembly**

Cause: Looseness of the fixing screws (54A) × 2

**< Repair and Adjustment >**

Fasten firm the screws (54A) × 2.

**Nikon**

**B, F, ER, UW-TUBE**

**for X and Y Microscopes**

**REPAIR MANUAL**

The repair guide for a beginner as well as an experienced technician.

**NIPPON KOGAKU K.K.**

Instruments group

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**CARE FOR STARTING REPAIR**


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**CARE FOR STARTING REPAIR**

- Keep as far as possible the lens surfaces free from dust, finger mark, etc.
- For dusting the lenses, use a soft hair brush or gauze. Only for removing finger marks, grease or the like, use a soft cloth, gauze or specified lens tissue soaked with a trifle of absolute alcohol (methanol or ethanol).
- For cleaning the parts painted or of plastic, avoid the use of organic solvents such as alcohol, ether, thinner.
- For the parts to which a specific oil has been applied, for maintaining the efficiency and accuracy, use the oil specified in the lubricant table.
- Handle at all times the parts carefully for fear of causing at any damage by shock.
- Use an appropriate amount of bonding agent to avoid overflow.
- For the times required for setting and separation of various bonding agents, refer to the following table.

	Time for setting	Caution	Separation
No. 2001	24 hours at normal temperature	Proceed to assembly, after setting.	Difficult. Strike it with hammer lightly or scrape it off.
No. 921	10-20 sec. at normal temperature		Difficult. Strike it with hammer lightly or scrape it off.
No. 350	24 hours at normal temperature	Used for locking screw. Apply it to threaded part, and screw in, thereafter leave it.	Apply a drop of alcohol for separation.
No. 2002	Does not set perfectly.	After applying, leave it for 10 - 15 min. and then stick.	Possible. Apply a drop of toluene.
No. 616	24 hours at normal temperature	After setting, proceed to assembly.	Difficult. Strike it lightly with hammer or scrape it off.
No. 503	24-48 hours at normal temperature. Check setting by touching with finger.	Even after setting, it shows elasticity.	Difficult. Scrape it off.

## TOOLS AND PREPARATIONS

## 1. Tools for General Use 2. Special Tools

## TOOLS AND PREPARATIONS

## 1. Tools for General Use

Item	Used for	B	F	UW	ER
4 + screwdriver set	Screwing in general	○	○	○	○
6 - screwdriver set	"	○	○	○	○
Tweezers (Stainless steel)		○	○	○	○
Blower	For cleaning lenses, etc.	○	○	○	○
Plastic hammer		○	○	○	○
Handlap	Containing absolute alcohol	○	○	○	○
Flat type thread driver		○	○	○	○

## 2. Special Tools

Item	Tool number	Used for	B	F	UW	ER
Tube length adjuster	J25148	For adjusting mechanical tube length.	○	○	○	○
Diopter telescope	J9008	For measuring parfocality and tube length.	○	○	○	○
Non-eccentric 10X Objective	J28018	For adjusting optical axis	○	○	○	○
Kellner eyepiece	J28006	"	○	○	○	○
Test plate (Check pattern)	J28004	"	○	○	○	○
One set of microscope stand		with Plan 10X, 40X, 100X and Plan Apo 10X.	○	○	○	○
CFW 10X			○	○	○	○
CFUW 10X		Ultra wide viewfield			○	
Photo focus adjusting tool		For focus adjustment of photo-tube.			○	
Standard straight tube (without Kellner)		For adjusting parfocality and tube length.	○	○	○	○
Dial gauge		"	○	○	○	○
Scale unit		"	○	○	○	○
Collimator 30° parallel	J25133		○	○	○	○
Tension gauge (500g, 1 Kg)			○	○	○	○
Special straight-tube (for common viewfield)		Used as straight-tube for depression prism unit.				
Special straight-tube (for ultra-wide field)		"				



## TOOLS AND PREPARATIONS

## 3. Lubricants

## 3. Lubricants

## 3-1. B-tube (Fig. 1 ~ 3)

	Item	Used for
Depression prism unit		None
Binocular body	G7920	(101) (central axle) and (102) (103) (right and left prism bases), (112) (washer) and (102), (103), (113) and (115).

## 3-2. F-tube (Fig. 2 ~ 4 and 6)

	Item	Used for
Depression prism unit	G6053	(5) (Photo-tube) and (11) (Clamp knob).
	L-4010	(1) (main body) (2) (Optical-path change-over chamber) and (21) (washer). (1) (13) (Retaining ring) and (14) (washer).
	G7910	(16) (Roller bearing roller) and (17) (Stainless steel rod).
	G7920	(7) (Positioning and locking tool and (22) (Plate spring), (9) (Prism base) and (20) (Central pin of rotation axle).
Binocular body	Same as 3-1. B-tube.	

## 3-3. UW-tube (Fig. 7 ~ 10)

	Item	Used for
Depression prism unit	G6053	(5) (Photo-tube) and (6) (Photo-tube clamp screw).
	G7910	(15) (Dovetail groove) and (52) (Prism holder) and (16) (Sliding plate).
	G7920	(51) (Central axle) and (52) (Right prism box) (53) (Left prism box), (51) (61) (Celluloid washer) (52) (53), (53) (62) (Celluloid washer) (63) (wave washer) (64) (washer) (58) (Torque adjusting screw)
Binocular body	G7920	(101) (Outer tube) and (102) (Lens chamber), (107) (Lead screw, female) and (108) (Lead screw, male), (151) (Outer tube) and (152) (Lens chamber), (157) (Lead screw, female) and (158) (Lead screw, male).

## 3-4. ER-tube (Fig. 2, 3)

	Item	Used for
Depression prism unit		None
Binocular body	Same as 3-1. B-tube.	

## TOOLS AND PREPARATIONS

## 4. Adhesive

## 4. Adhesive

## 4-1. B-tube (Fig. 1 ~ 3)

	Item	Used for
Depression prism unit	No. 2001	Ⓒ3 (30° depression prism) and Ⓒ2 (mount), Ⓒ1 Ⓒ2 (Convex, concave lenses) and Ⓒ3 (Lens chamber).
	No. 350	Ⓒ3 and Ⓒ4 (Retaining ring)
Binocular body	No. 2001	Ⓒ6 (Rhomboidal prism) and Ⓒ103 (Prism box, left), Ⓒ6 Ⓒ7 (Rectangular prism) and Ⓒ102 (Prism box, right), Ⓒ8 (Plane-parallel glass) and Ⓒ106 (Eyepiece sleeve, right)
	No. 350	Ⓒ102 and Ⓒ143A x2 (Screws), Ⓒ103 and Ⓒ109 (Central axle cap), Ⓒ103 and Ⓒ143A x2, Ⓒ105 (Eyepiece sleeve, left) and Ⓒ107 (Eyepiece sleeve cover), Ⓒ106 and Ⓒ107.
	No. 921	Ⓒ106 and Ⓒ8 (Plane-parallel glass)
	No. 2002	Ⓒ109 (Central axle cap) and Ⓒ111 (interpupillary distance scale plate), Ⓒ116 x3 (Light stop plates) and Ⓒ6 Ⓒ7.

## 4-2. F-tube (Fig. 2 ~ 6)

	Item	Used for
Depression prism unit	No. 2001	Ⓒ6 (Lens chamber) and Ⓒ1 Ⓒ2, Ⓒ9 (Prism base) and Ⓒ3.
	No. 350	Ⓒ2 (Optical-path change-over chamber) and Ⓒ13 (Retaining ring), Ⓒ2 and Ⓒ538 x2.
	No. 921	Ⓒ22 (Plate spring) and Ⓒ23 (Spring retainer)
	No. 501	Ⓒ3 (Dovetail bayonet) and Ⓒ15 (washer), Ⓒ3 and Ⓒ24 (washer), Ⓒ25 x4 (Name plate) and Ⓒ8-1 (Binocular body attaching plate).
	No. 616	Ⓒ3 and Ⓒ20 (Central pin of rotation axle), Ⓒ9 (Prism base) and Ⓒ10-1 x2 (Roller guide), Ⓒ11 (Photo-tube clamp screw) and Ⓒ12 (Bush).
Binocular body	Same as 4-1. B-tube	

## TOOLS AND PREPARATIONS

## 4. Adhesive 5. Others to be Repaired

## 4-3. UW-tube (Fig. 7 ~ 10)

	Item	Used for
Depression prism unit	No. 2001	Ⓒ3 (30° depression prism) and Ⓒ12 (Prism holder dovetail groove).
	No. 350	Ⓒ9 (30° depression prism chamber) and Ⓒ83B x2 (Screws), Ⓒ17 (Bottom plate) and Ⓒ83A x2 Ⓒ83C x2 Ⓒ83D x2 (Screws).
	No. 501	Ⓒ2 (Lens chamber) and Ⓒ8 (Light stop plate)
	No. 503	Ⓒ10 (Lens chamber) and ⒸG4 ⒸG5 (Concave, convex lenses)
	No. 616	Ⓒ3 (Lens outer tube) and Ⓒ4 (Lens inner tube), Ⓒ6 (Photo-tube clamp screw) and Ⓒ7 (Bush), Ⓒ13 (Optical-path change-over rod) and Ⓒ14 (Optical-path change knob).
Binocular body	No. 2001	ⒸG6 (Rhomboidal prism) and Ⓒ53 (Prism box, left), ⒸG6 ⒸG7 (Rectangular prism) and Ⓒ52 (Prism box, right).
	No. 350	Ⓒ52 and Ⓒ83D x2 (Screws), Ⓒ53 and Ⓒ83D x2, Ⓒ53 and Ⓒ59 (Central axle cap), Ⓒ55 (Eyepiece sleeve, left) and Ⓒ57 (Eyepiece sleeve cover), Ⓒ56 (Eyepiece sleeve, right) and Ⓒ57.
	No. 921	ⒸG8 (Plane-parallel glass) and Ⓒ56.
	No. 2002	ⒸG6 (Rhomboidal prism) and Ⓒ65B (Screw), ⒸG6 ⒸG7 (Rectangular prism) and Ⓒ65B, Ⓒ56 and Ⓒ68 (Light stop ring), Ⓒ59 and Ⓒ60 (Interpupillary distance scale plate).
Photo-tube	No. 350	Ⓒ102 x2 (Lens chamber) and Ⓒ107 x2 (Lead screw, female), Ⓒ152 (Lens chamber) and Ⓒ157 (Lead screw, female).
	No. 503	ⒸG37 (Photo mask plate) and Ⓒ159 (Photo mask chamber).

## 4-4. ER-tube (Fig. 2 and 3)

	Item	Used for
Depression prism unit	No. 2001	Ⓒ2 (mount) and ⒸG3 (Roof prism)
Binocular body	Same as 4-1. B-tube.	

## 5. Others to be repaired

- Absolute alcohol (ethanol and methanol)
- Lens tissue or clean cloth



B-tube (Binocular body)

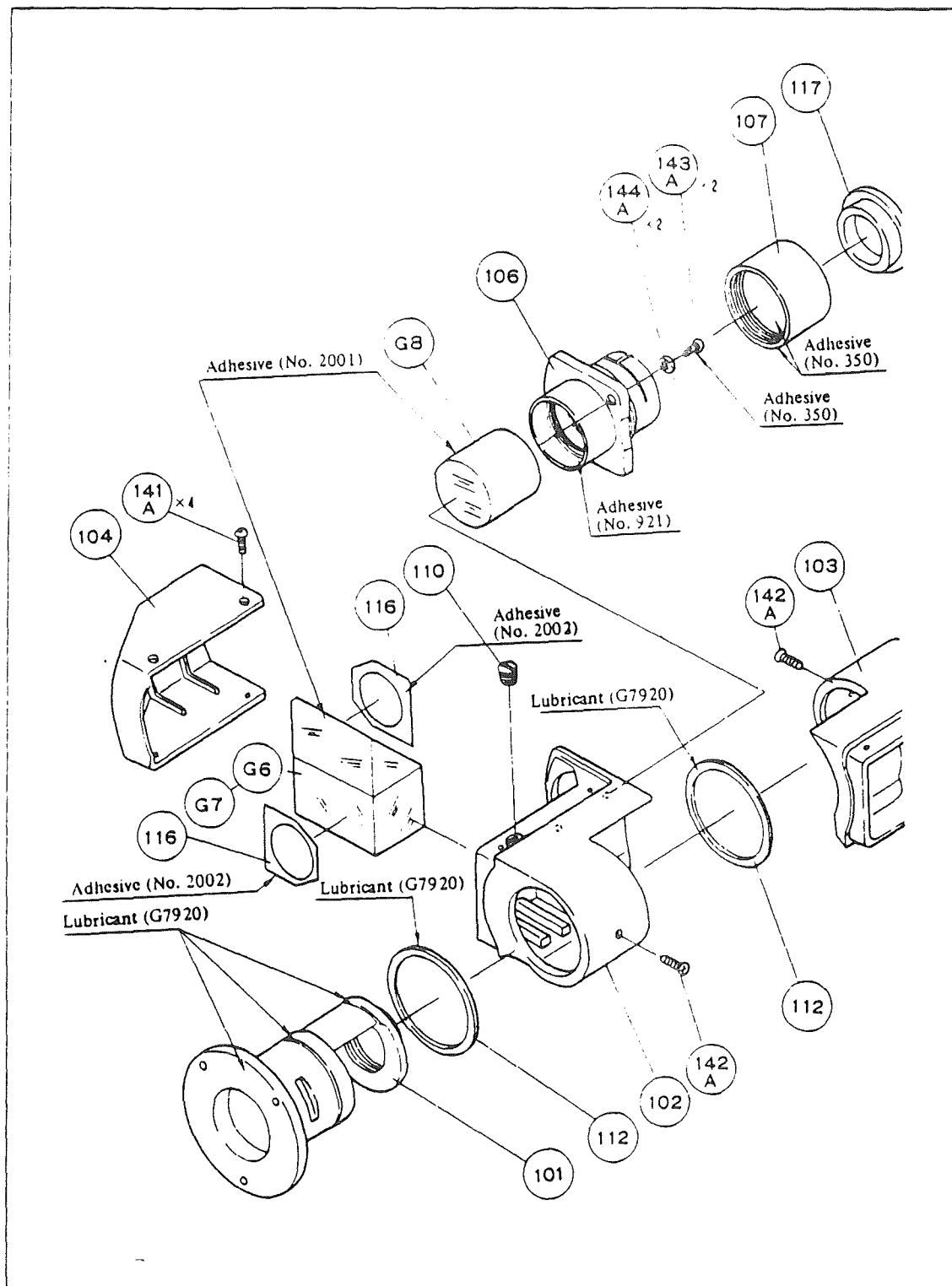


Fig. 2

Application of Lubricant and Adhesive

TOOLS AND PREPARATIONS

B-tube (Binocular body)

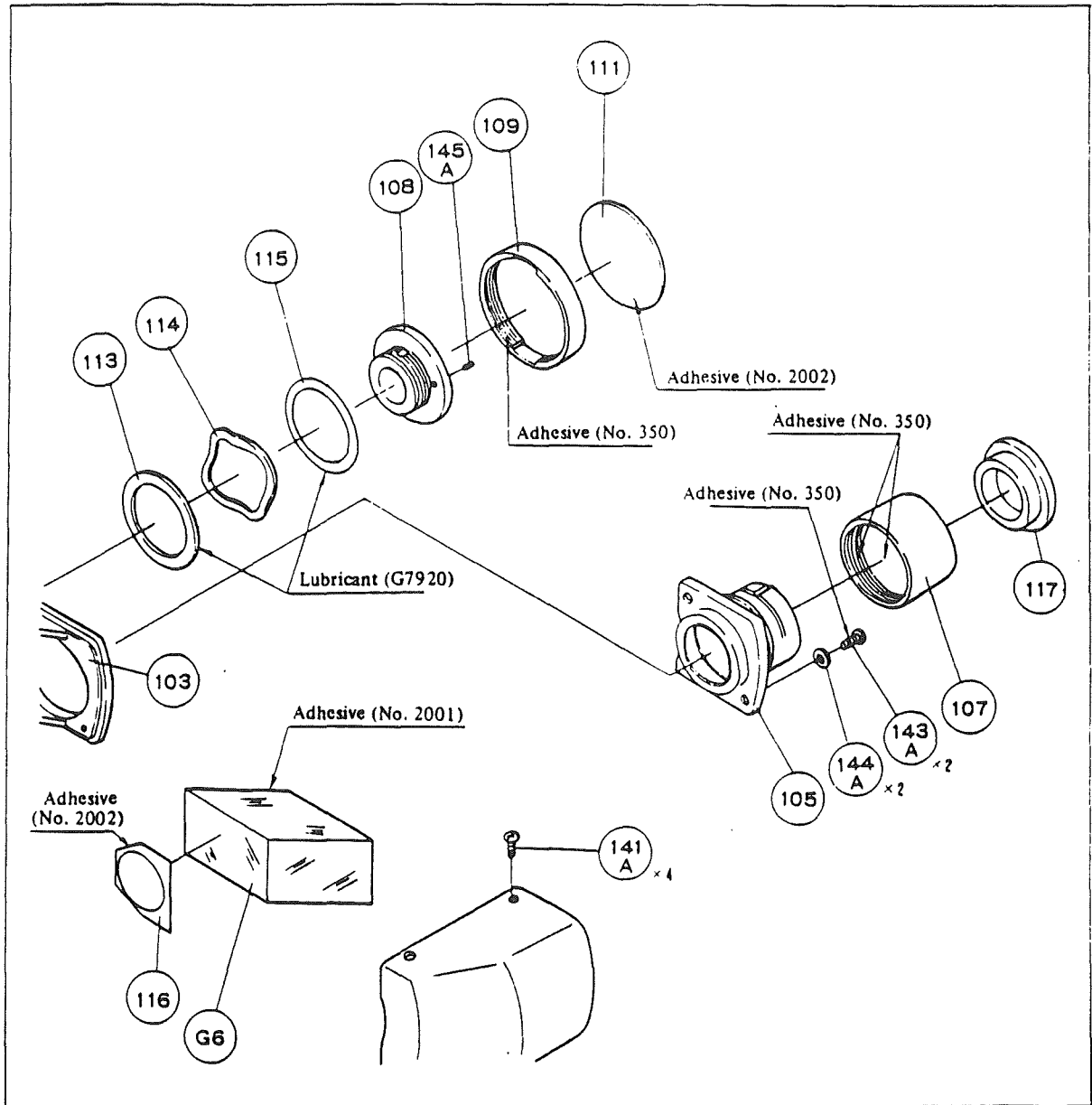


Fig. 3

Application of Lubricant and Adhesive

TOOLS AND PREPARATIONS

F-tube (Depression prism)

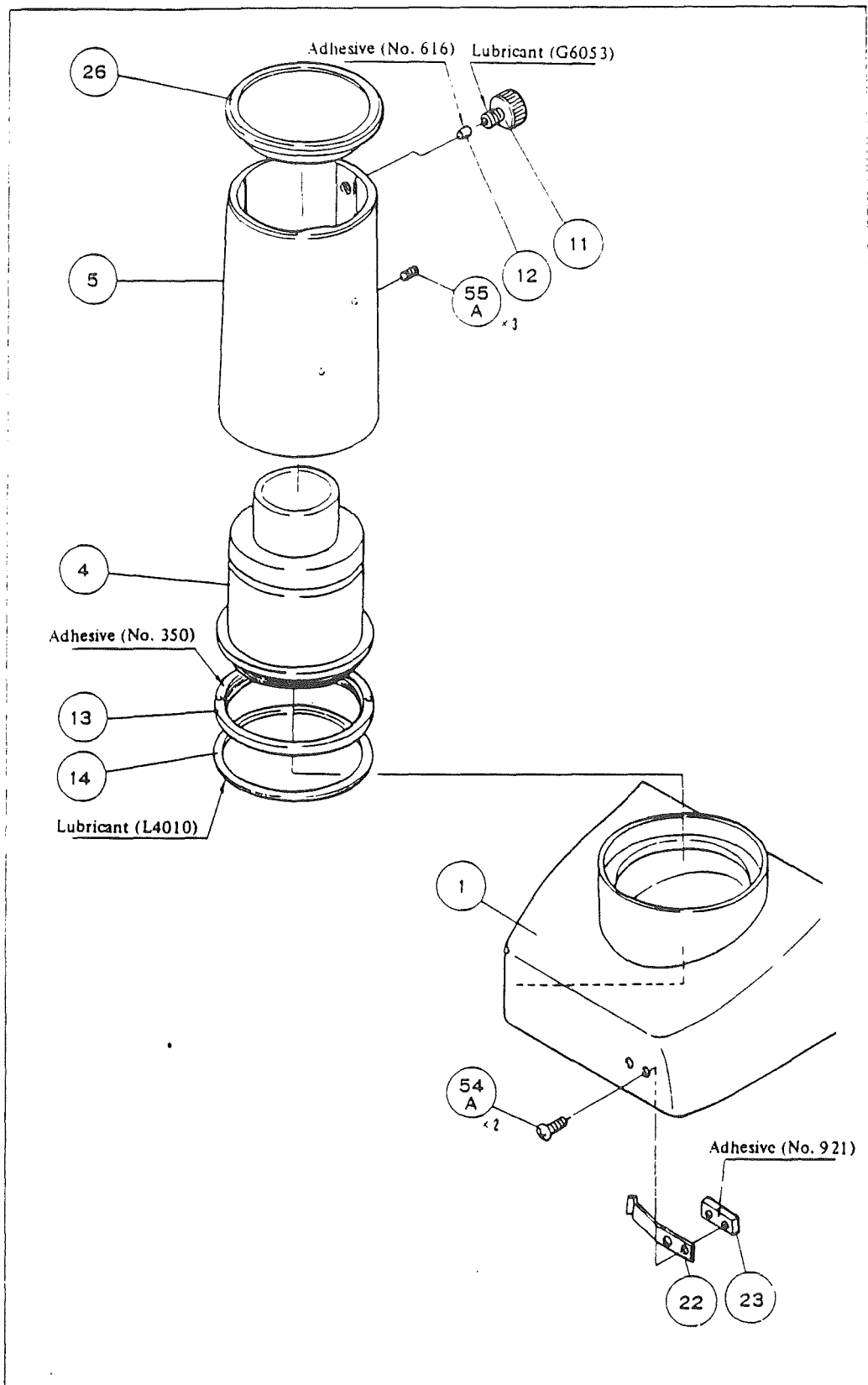


Fig. 4

Application of Lubricant and Adhesive

TOOLS AND PREPARATIONS

F-tube (Depression prism)

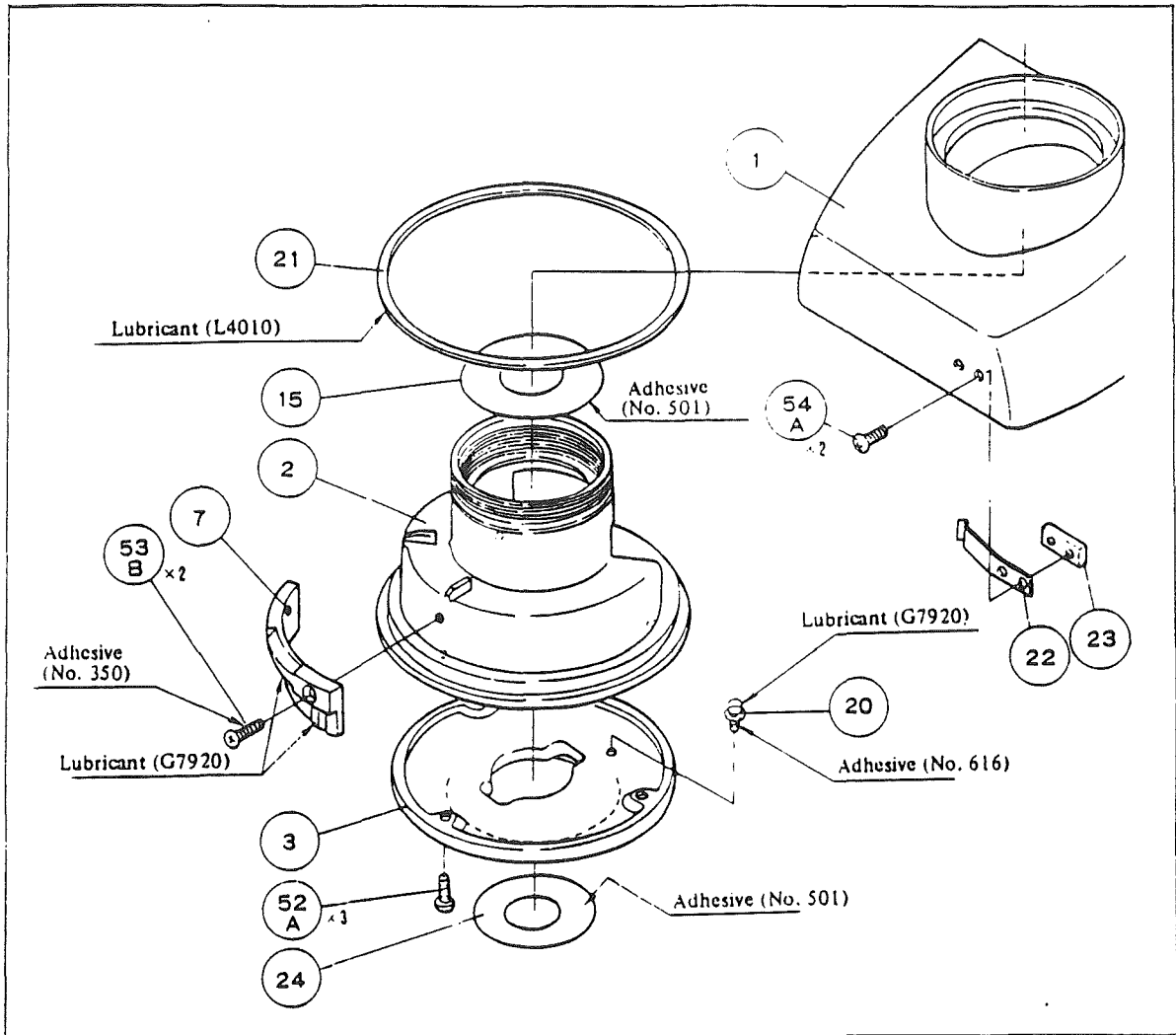


Fig. 5

Application of Lubricant and Adhesive



TOOLS AND PREPARATIONS

F-tube (Depression prism)

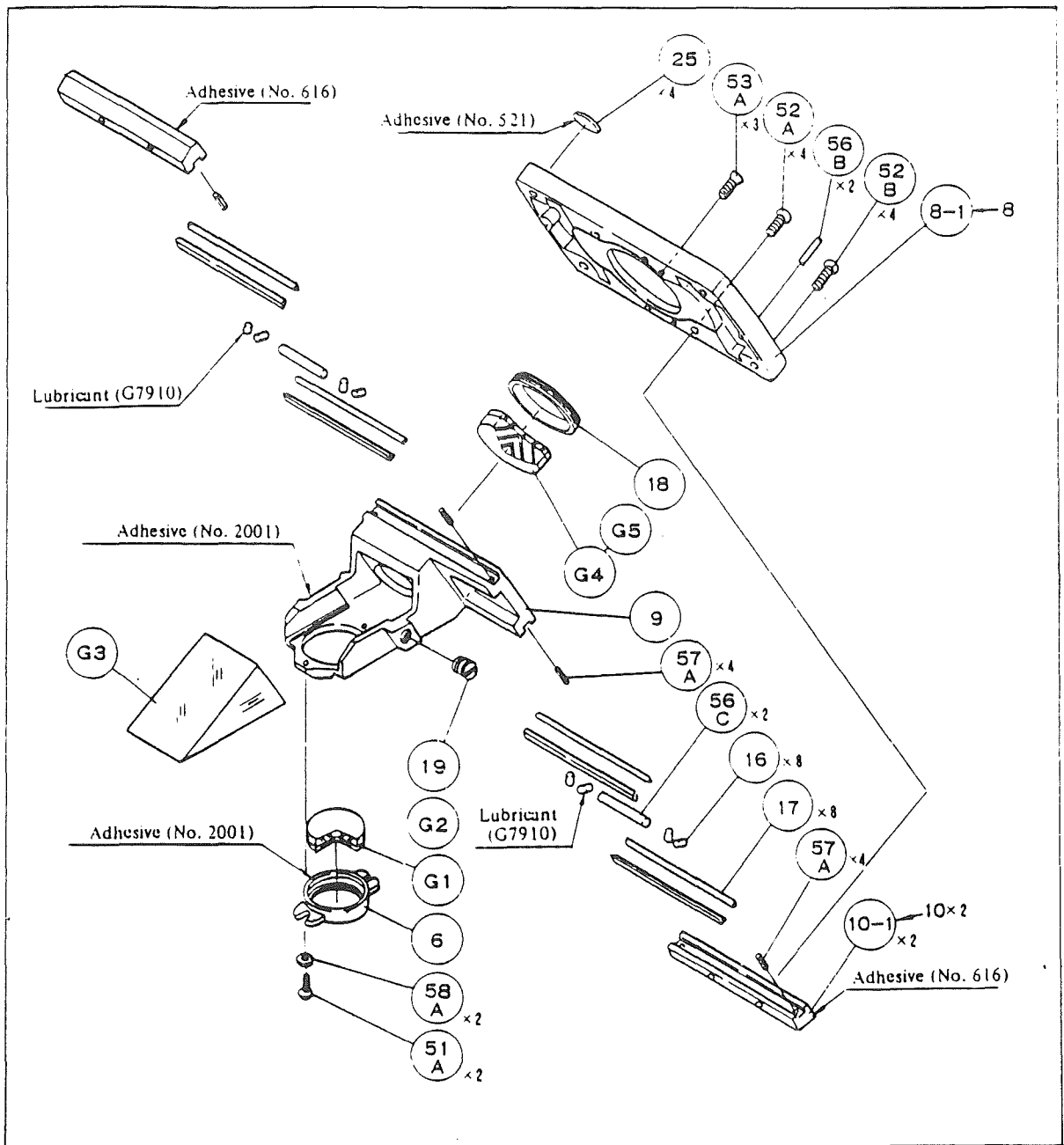


Fig. 6

Application of Lubricant and Adhesive

TOOLS AND PREPARATIONS

UW-tube (Photo tube)

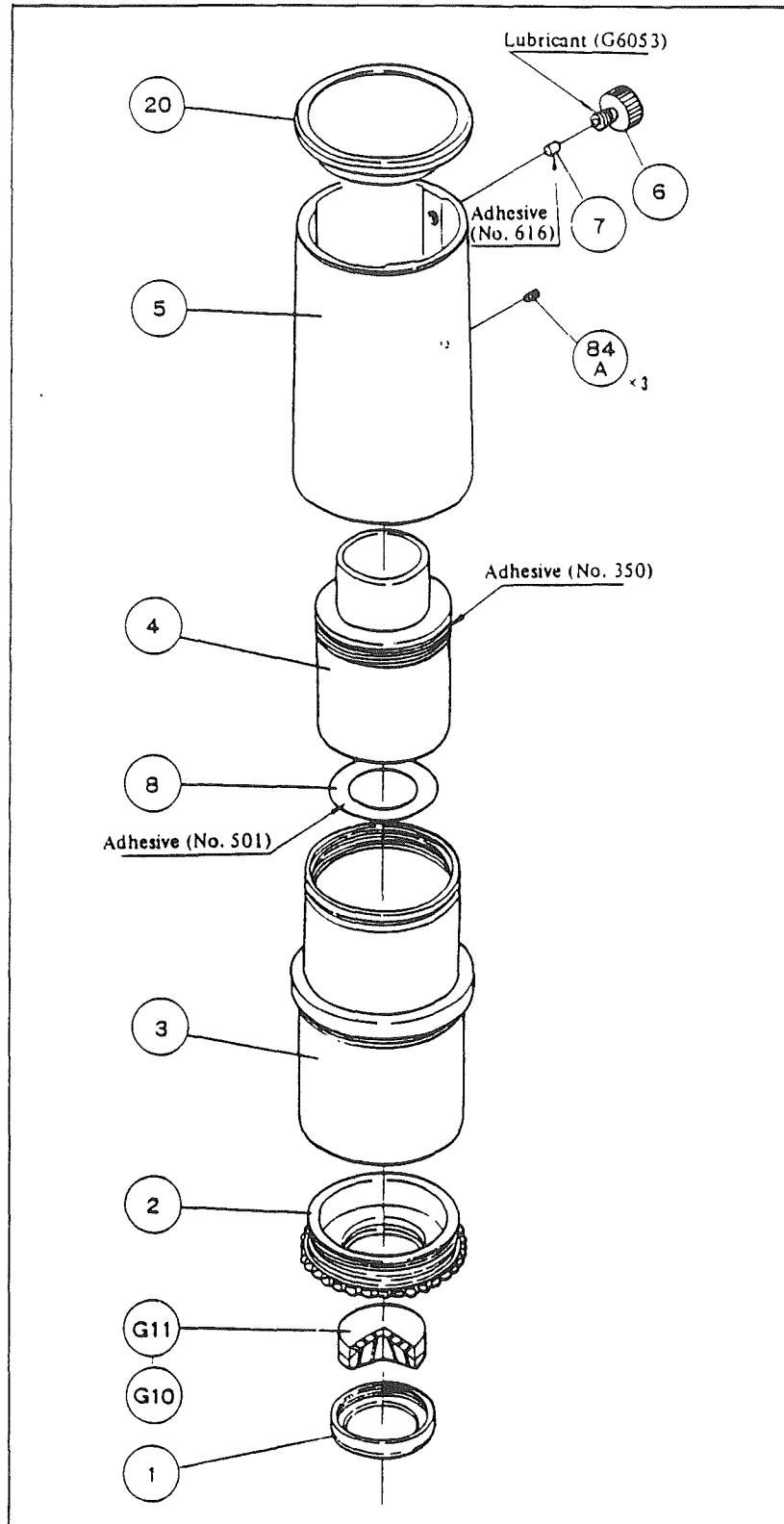


Fig. 7

Application of Lubricant and Adhesive

TOOLS AND PREPARATIONS

UW-tube (Depression prism)

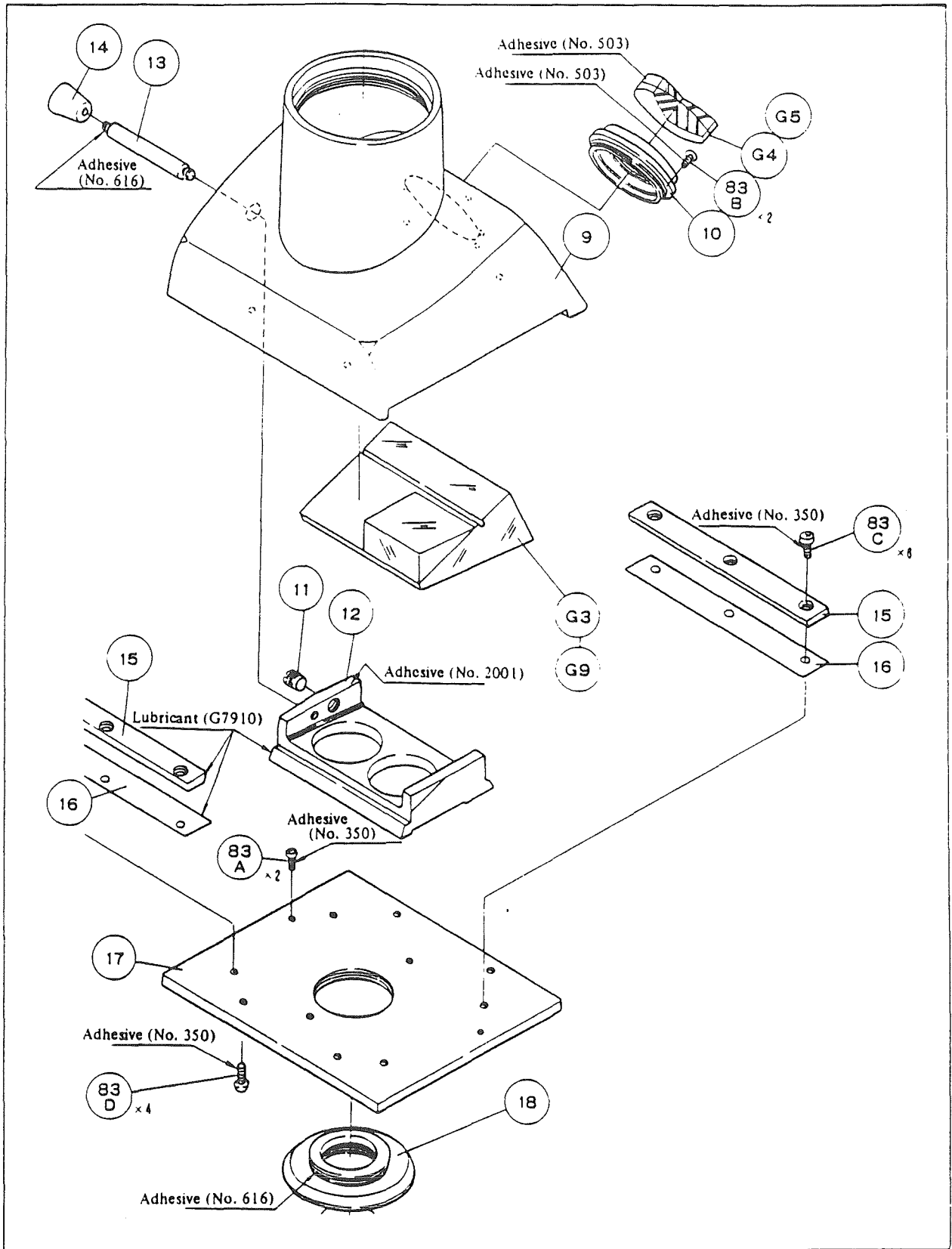


Fig. 8

Application of Lubricant and Adhesive

TOOLS AND PREPARATIONS

UW-tube (Binocular body)

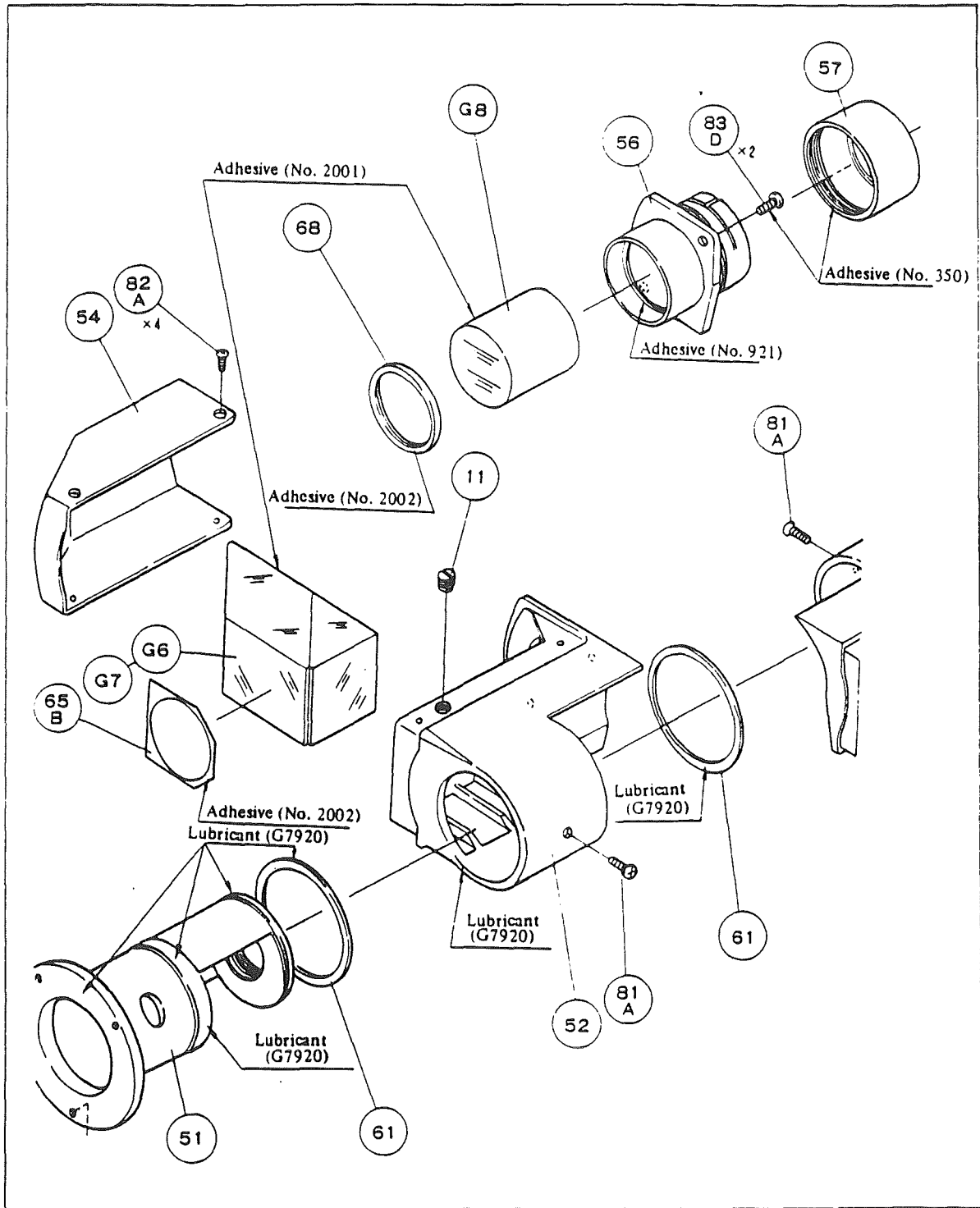


Fig. 9

Application of Lubricant and Adhesive

TOOLS AND PREPARATIONS

UW-tube (Beinocular body)

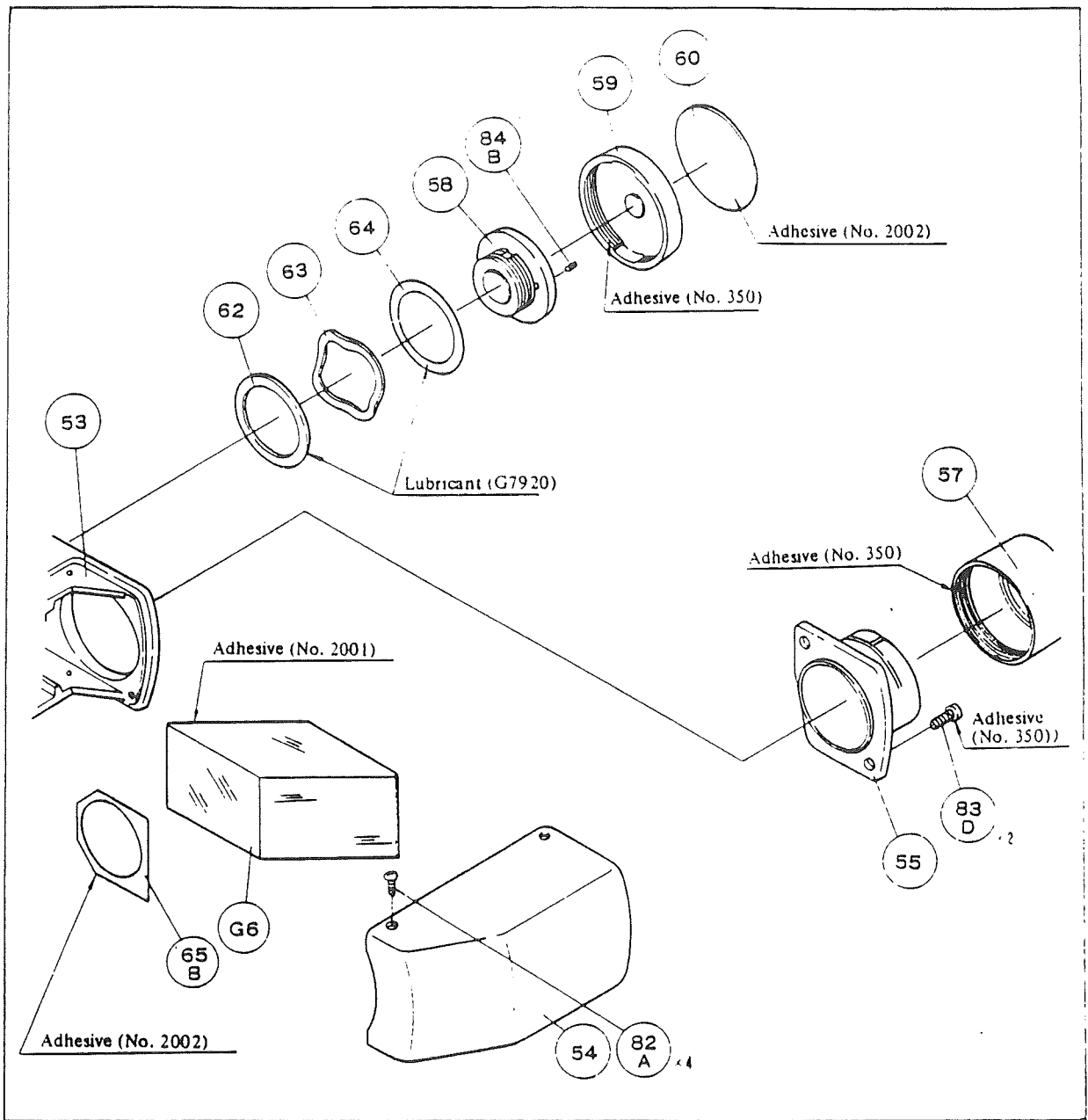


Fig. 10

Application of Lubricant and Adhesive

TOOLS AND PREPARATIONS

ER-tube (Depression prism)

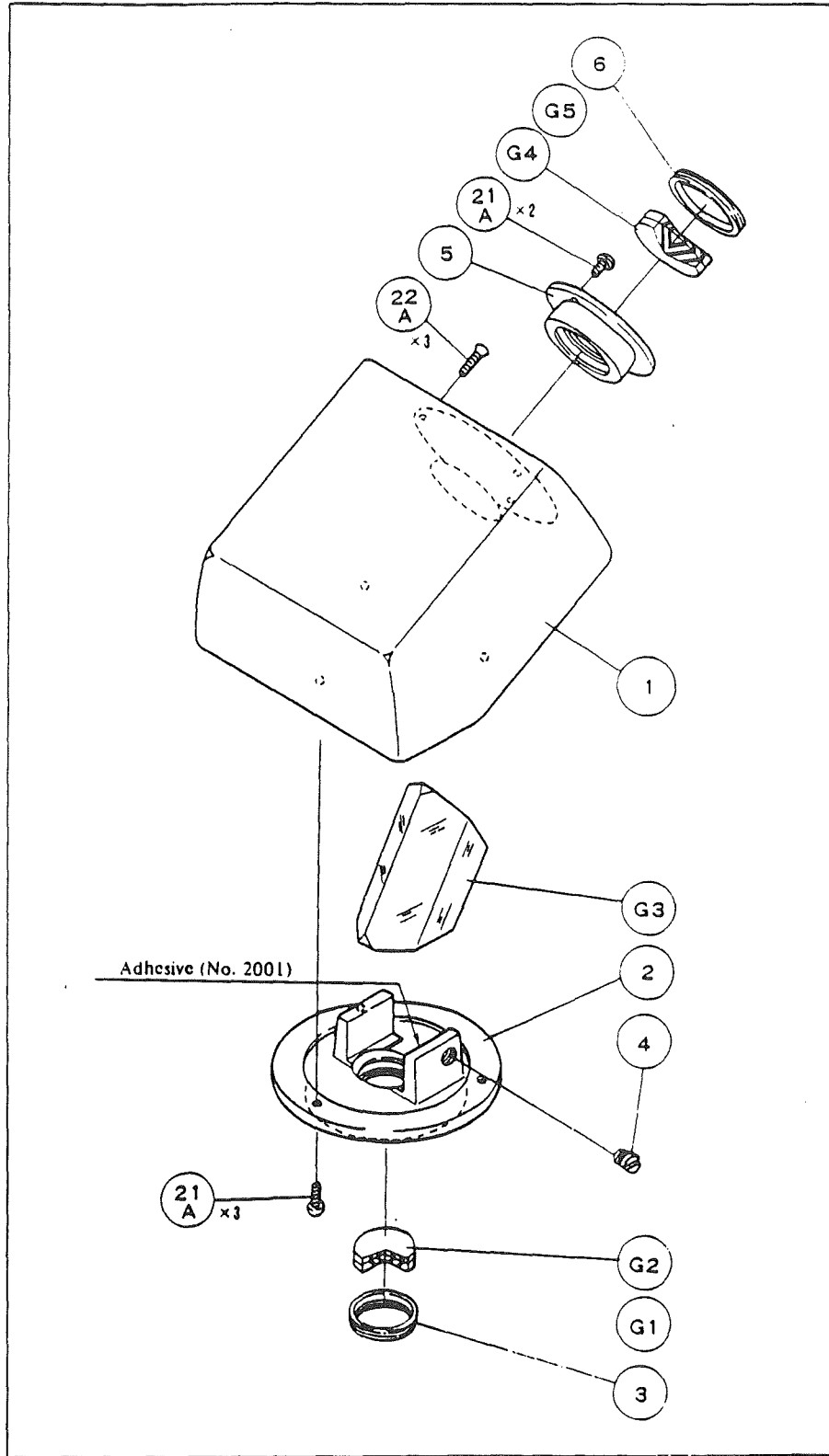


Fig. 11

Application of Lubricant and Adhesive

## MECHANISM AND PRINCIPLE

## 1. B-tube

- Depression angle of binocular body:  $30^\circ$   
Tube magnification:  $1\times$  (with built-in relay lenses)
- Spring type eyepiece sleeve will cause no slack of the eyepiece.
- Special beam splitter offers brighter images.
- Owing to Siedentopf type adopted, even though the interpupillary distance is changed (ranging  $51 \sim 75$  mm), for which prism cover (104) is vertically turned and moved, the tube length remains constant all the times.
- Diopter adjustment is performed not with the adjusting collar, but with the eyepiece with a range of  $-8 \sim +5$  dptr.
- Tightness of interpupillary distance adjustment can be changed by the rotation of torque adjusting screw (108).

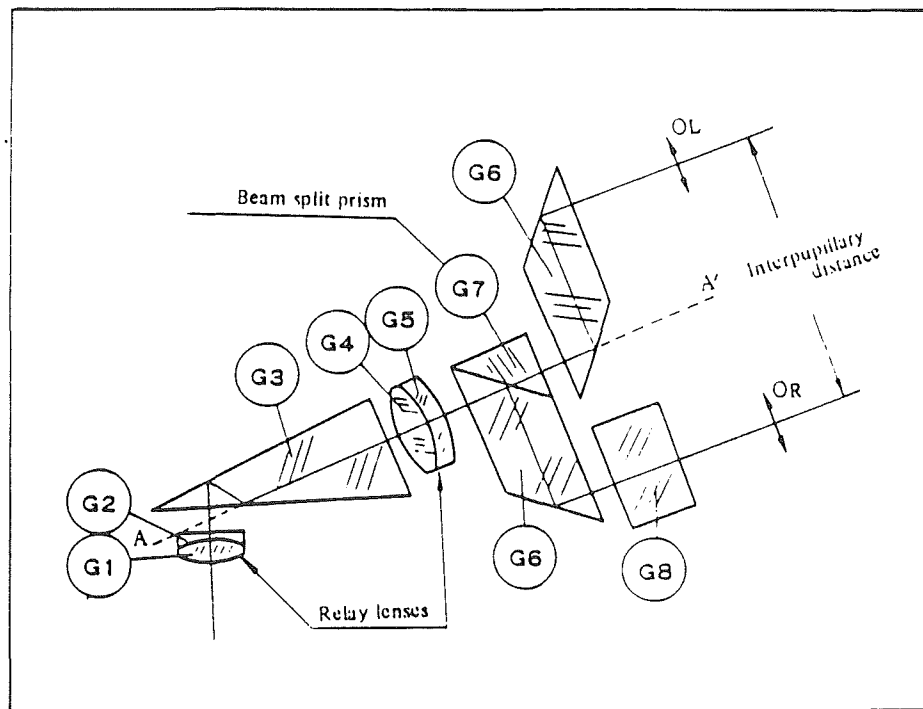


Fig. 12

- As shown in Fig. 12 images are produced at OL and OR by the parallel ray beams between (G1), (G2). The right and left side prisms ((G6) and (G7)) are revolved round the axis AA'.

## 2. F-tube

- Depression angle of binocular body  $30^\circ$
- Tube magnification: 1X
- Spring type eyepiece sleeve will cause no slack of the eyepiece.
- Special beam splitter offers brighter images.
- Owing to Siedentopf type adopted, even though the interpupillary distance is changed (within a range of 51 ~ 75 mm), for which prism cover (104) is vertically turned and moved, the tube length remains constant all the times.
- Diopter adjustment is performed not with the adjustment collar, but with the eyepiece with a range of  $-8 \sim +5$  dptr.
- Two-step optical-path change-over system sending a light intensity of 100% for observation or 100% for photography.

For observation, the 1X relay lenses are brought into the optical-path, and for photography, when the binocular body is turned  $60^\circ$  to the left, relay lenses (G1) and (G2) and depression prism (G3) are swung out, thus all the optical elements for photo-tube being taken out of the optical-path.

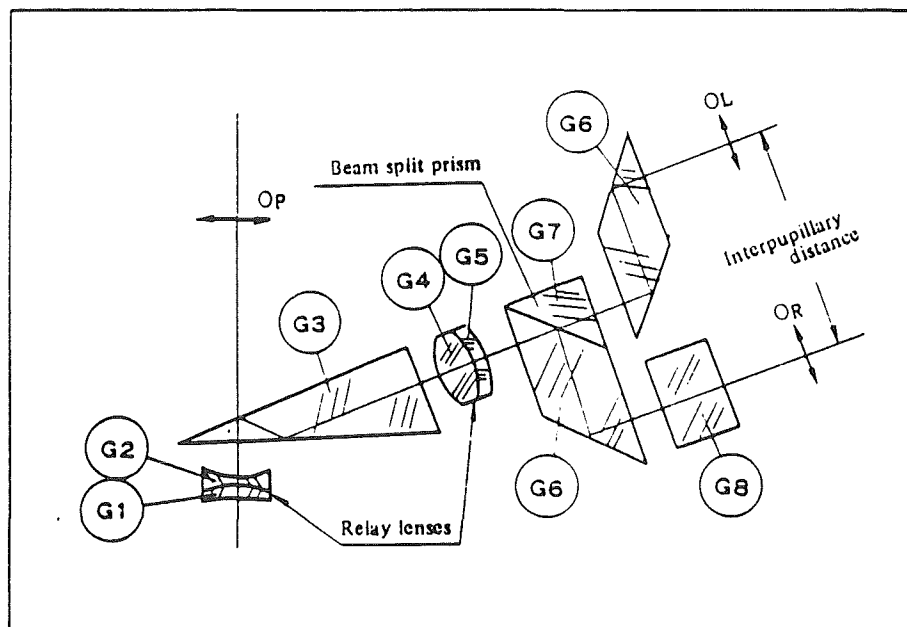


Fig. 13

- Images are produced at OL and OR by the parallel ray beams between (G1), (G2) and (G4), (G5).



## 3. UW-tube

- Depression angle of binocular body:  $30^\circ$
- Tube magnification: 1X
- Special beam splitter will cause no slack of the eyepiece.
- Owing to Siedentopf type adopted, even though the interpupillary distance is changed (within a range of 54 ~ 75mm), for which prism cover (54) is vertically turned and moved, the tube length remains constant all the times.
- Diopter adjustment is performed not by an adjusting collar but by the eyepiece with a range of  $-8 \sim +5$  dptr.
- Two step optical-path change-over system, sending a light intensity of 100% for observation or 86%/14% for photography/observation with the 1X relay lenses inserted.

Focusing in photography is possible with the binocular body, because the parfocality between the image positions OL and OR and that in Photo-tube is exactly maintained.

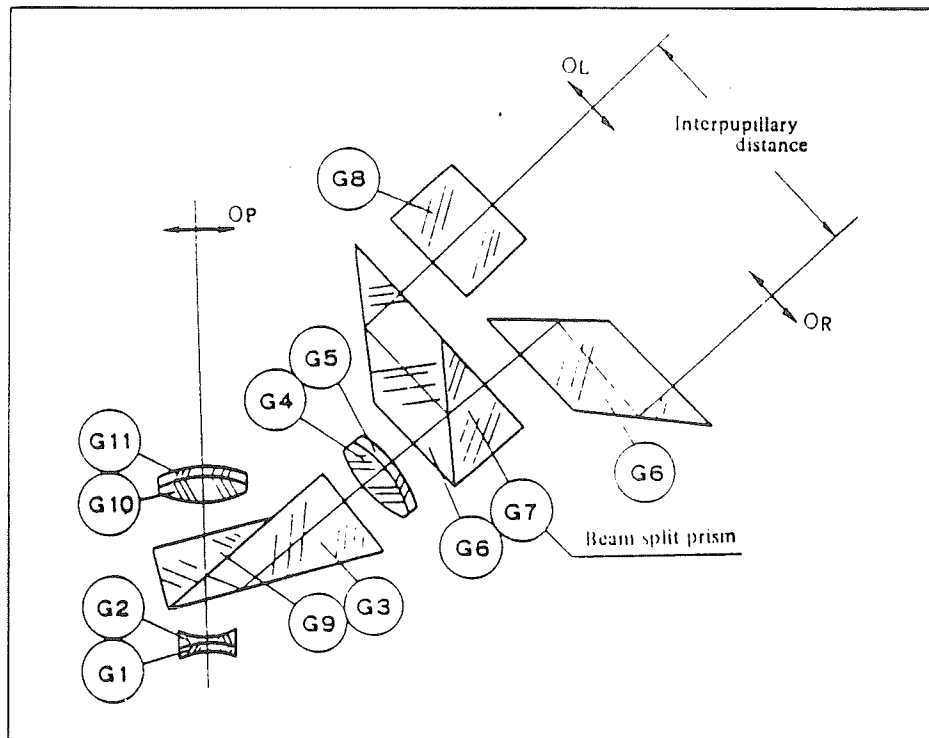


Fig. 14

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**MECHANISM AND PRINCIPLE**

---

**3. UW-tube**

- Inclination  $5.2^\circ$  of prisms (G3) and (G9) from the optical axis, which is made possible by the parallel light rays after (G1) and (G2), to avoid ghost images caused by reflection on the prisms.
- Optical axis of (G10), (G11) in Photo-tube, though cause halving, on account of the inclination of (G3) and (G9), are assumed to be that, if not such halving would be considered, i.e. the elongation of the axis of (G1) (G2).
- As shown in Fig. 14, the images at OL and OR are produced by the parallel ray beams between (G1), (G2) and (G4), (G5), as well as (G1), (G2) and (G10), (G11).
- Image position OP of Photo-tube is adjusted by changing its tube length using a collimator, so that the image is located on the focal point of (G10), (G11).
- Image positions OL and OR in the binocular body are adjusted by means of eyepiece sleeve cover (57), so that they are parfocal with the image OP of Photo-tube.
- UW-tube permits observation of a wide viewfield of 26.5mm in dia., using 10X objective.

## 4. ER-tube (Erect image binocular-tube)

This ER-tube provided with a roof-type depression prism, produces erect images.

- Depression angle:  $30^\circ$
- Tube magnification:  $1\times$
- Special beam splitter offers brighter images.
- Owing to Siedentopf type adopted, even though the interpupillary distance is changed between  $51 \sim 75$  mm, for which prism cover (104) is vertically turned and moved, the tube length keeps constant all the times.
- Optical system in the binocular body following the beam splitter prism is constructed the same as for B-tube.
- As shown in Fig. 5, the light rays between (G1), (G2) and (G4), (G5) are made parallel.

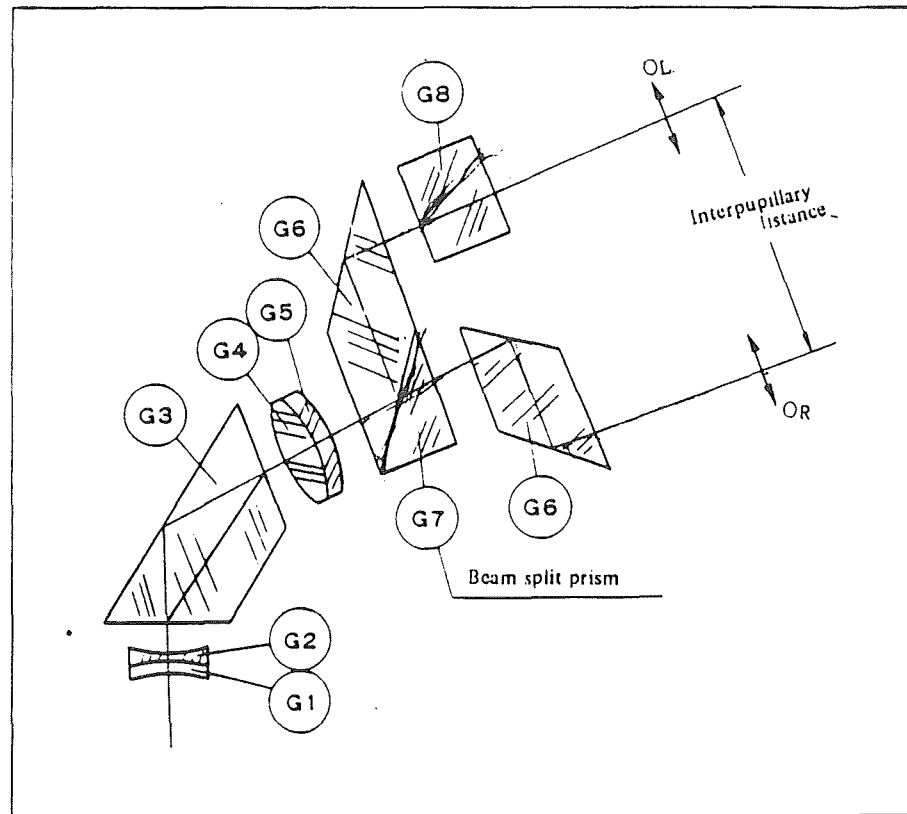


Fig. 15

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**DISASSEMBLY PROCEDURE**

---

1. B-tube    2. F-tube

**DISASSEMBLY PROCEDURE****1. B-tube**

Release screws (22A) x 3, used for attaching main body (1) and central axle (101), and separate the binocular body from the depression prism unit.

## 1) Binocular body

For disassembly, refer to Fig. 2 and 3, taking the cautions as below:

- To dissolve adhesive No. 350, apply alcohol.
- The other adhesives, not dissolvable with alcohol, is to be removed by striking with a plastic or wooden hammer. If not removable, break the glass and scrape off the adhesive.
- To separate No. 2002, apply a drop of toluene.

## 2) Depression prism unit

For disassembly, refer to Fig. 1, taking the cautions as below:

- To dissolve adhesive No. 350, apply alcohol.  
No. 2001 being not dissolvable, use a plastic or wooden hammer. If not removable, break the glass and scrape off the adhesive.

**2. F-tube**

Release screws (53A) x 3, and separate the binocular body from the depression prism unit.

## 1) Binocular body

For disassembly, follow the same procedure as for B-tube.

## 2) Depression prism unit

To disassemble the prism unit, refer to Fig. 4, 5 and 6, taking the cautions as below:

- To dissolve adhesive No. 350, apply alcohol.  
No. 2001, No. 921, 501 and 616 being not dissolvable with alcohol, use a plastic or wooden hammer to strike it out. If not removable, break the glass and scrape off the adhesive.
- For dissolving No. 2002, apply a drop of toluene.
- Take off only the upper one of roller guides (10), the lower one being to be remained as fiducial.

---

**DISASSEMBLY PROCEDURE**

---

3. UW-tube 4. ER-tube

---

**3. UW-tube**

Release screw (81B) x3, and separate the binocular body from the depression prism unit.

## 1) Photo-tube

For disassembly, refer to Fig. 7, taking the cautions as below:

- When taking off Photo-tube sleeve (4) out of internal tube (3), mark off a line on the sleeve (4), to regain the original position.

## 2) To disassemble the binocular body, refer to Fig. 9 and 10.

## 3) To disassemble the depression prism unit, refer to Fig. 8, taking the cautions as below:

- Do not remove simultaneously both the dovetail grooves (15) from bottom plate (17), because either is to be used as fiducial, when reassembling.

**4. ER-tube**

Release screws (22A) x3 and separate the binocular body from the depression prism unit.

## 1) Binocular body

For disassembly, follow the same procedure as for B-tube.

## 2) Depression prism unit

For disassembly, refer to Fig. 11.

## REASSEMBLY PROCEDURE


## 1. B-tube

## REASSEMBLY PROCEDURE

Before reassembly, clear off dirt from the lenses, prisms and metal parts.

## 1. B-tube

1-1. Depression prism unit (Refer to Fig. 1)

- 1) Insert the lens chamber (3) (with G1 and G2 inside, to be positioned as  thicker), and screw in retaining ring (4). Applying adhesive No. 350, attach (4) to (3) after adjusting the optical axis (P. 40).

- 2) Assemble prism (G3) on the mount (2), and fix it with plastic screw (6), temporarily. Set the prism in such a position as shown in Fig. 16, that the end surface of the prism holder coincides with the bottom edge of the 30° surface of the prism (G3). (Fig. 16)

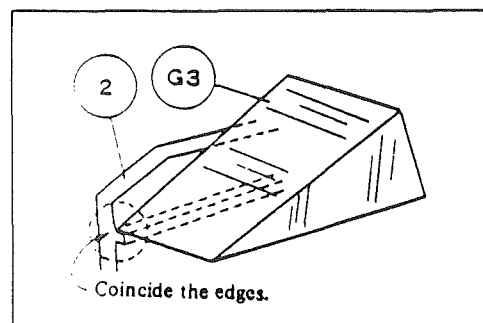



Fig. 16

- 3) Attach (2) to main body (1) with screws

(21A) x3

- 4) Insert lenses (G4) and (G5) into main body (1) and screw in retaining ring (7) (the positions of the lenses are to be  thicker).

1-2. Binocular body (Refer to Fig. 2 and 3)

- 1) Insert washer (112) into the central axle (101). (Apply oil G7920 to both the surfaces).
- 2) Insert righthand prism box (102) into the central axle (101). (Apply oil G7920) to the fit and thrust surfaces).

Note: Do not apply so much oil as to enter the prism box. Over-full oil should be wiped off.

- 3) Insert rotation limit screw (142a) x1 into the groove on (101) from the outside of (102).  
Check the full range of operation from limit to limit.

- 4) Insert washer (112) into the central axle (101). (Apply oil G7920 to both the surfaces).

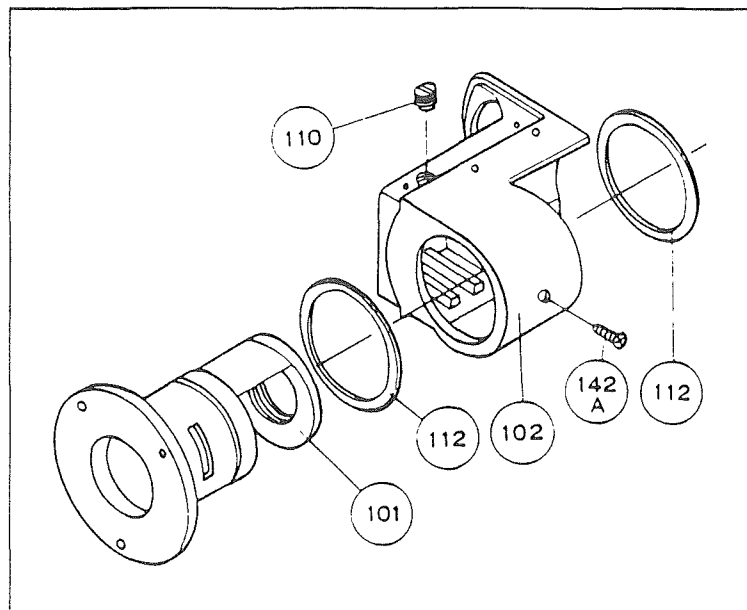


Fig. 17

- 5) Fit left hand prism box (103) to the central axle (101). (Apply oil G7920 to the fit and thrust surfaces).

Note: Do not apply so much oil as to enter the prism box. Over-full oil should be wiped off.

- 6) Insert rotation limit screw (142A) into the groove on (101) from the outside of (103).  
Check the full range of operation from limit to limit.

- 7) Insert washers (113), wave-formed washer (114) and washer (115) into (103).  
(Apply oil G7920 to (113))

- 8) Screwing in rotation-tightness adjusting knob (108) into (101), make the torque 1.5 Kg ~ 2 Kg. To measure the torque, use a tension gauge in the direction of the arrow in Fig. 18.

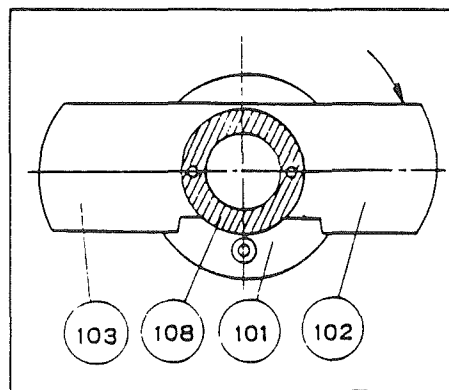


Fig. 18

## REASSEMBLY PROCEDURE

## 1. B-tube

- 9) Stick prism (G8) to righteye sleeve (106), using No. 2001. Apply this adhesive in a ring all around the top edge of (G8), and inserting (G8) into (106), rotate it several times.
- 10) Attach (106) to prism base (102) with washer (144A) and screws (143A) x2 temporarily. Thereafter, screw in cover ring (107) into (102). (After positional adjustment, stick it with No. 350)
- 11) Attach lefteye sleeve (105) to prism base (103) with washer (144A) and screws (143) x2 temporarily. Thereafter, screw in (107) into (102). (After adjustment, stick it with No. 350)
- 12) Stick plates (116) x2 to light incidence and exit surfaces of (G6), (G7) with adhesive No. 2002. Apply the adhesive in a ring onto the attaching surfaces of the stop plates. After about 30 minutes, attach them to the prisms. Apply black paint to the groove and attaching parts as shown in Fig. 19.

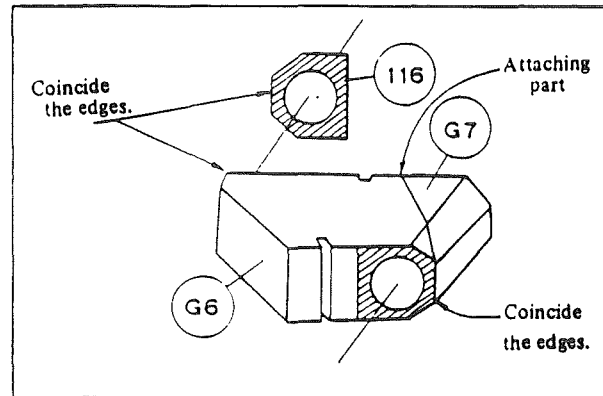


Fig. 19

- 13) Stick light stop plate (116) onto the light incidence surface of prism (G6) in the same way as mentioned in 12).
- 14) Attach prisms (G6), (G7) to (102), and fix them with plastic screw (110) temporarily. (After positional adjustment, stick them using No. 2001.) (Fig. 20)

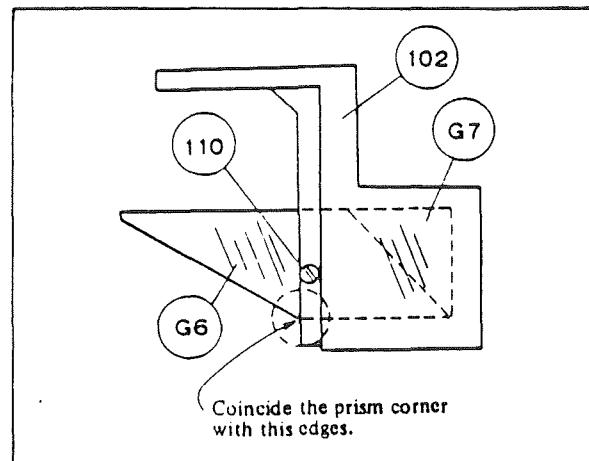


Fig. 20



## REASSEMBLY PROCEDURE

1. B-tube

- 15) Attach prism (G6) onto lefthand prism box (103), and fix it with plastic screw, transitorily.  
(After positional adjustment, stick it using No. 2001.) (Fig. 21)

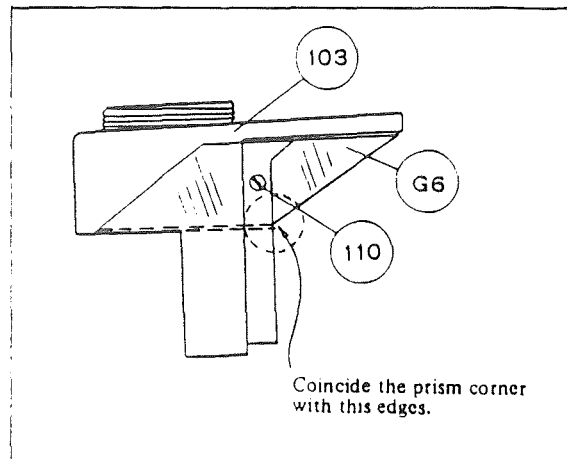


Fig. 21

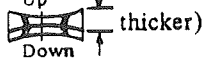
- 16) After adjusting the optical axis, attach the cover parts as below: (109) and (111) to (103), using adhesive No. 350; (104) to (102) and (104) to (103), using screws (141A) x 4.
- 17) Finally, after adjusting the optical axis of the depression prism, attach the binocular body to the depression prism unit with screw (S3A) x 3.

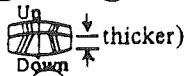
## REASSEMBLY PROCEDURE

## 2. F-tube

## 2. F-tube

## 2-1. Depression prism unit (Refer to Fig. 5 and 6)

- 1) Attach lens chamber (6) (with (G1) and (G2) inside, to be positioned as  thicker) to prism holder (9), using washer (58A) and screw (51A) x 2.

- 2) Insert lenses (G4) and (G5) (positioned as  thicker) into prism holder (9), and fix them with retaining ring (18).

- 3) Place cylindrical rollers (16) x 4 and parallel pin 56C on the fiducial roller race (10-1) attached to binocular body attaching plate (8-1), through (17) x 2 (Fig. 23). Apply oil G7920 to (16) and (56C).

- 4) Place the lower side of roller race (9) onto cylindrical rollers (16) of the above cited fiducial rollers race (10-1), and (16) x 4 and (56C) onto the upper surface of roller race (9), through (17) x 2.

- 5) Apply adhesive No. 616 to the contact surface (81) (at three points), and attach (8-1) to (10-1) with screws (52A) x 2 temporarily.

- 6) Make positional adjustment of

(9) on the upper surface of

(10-1), so that (9) operates smoothly without any slack in respect to roller race (10-1) x 2 of

(8-1). Fix it with screw (52A) x 2.

Operating torque of (9) is to be 50g ~ 60g, measured with a tension gauge.

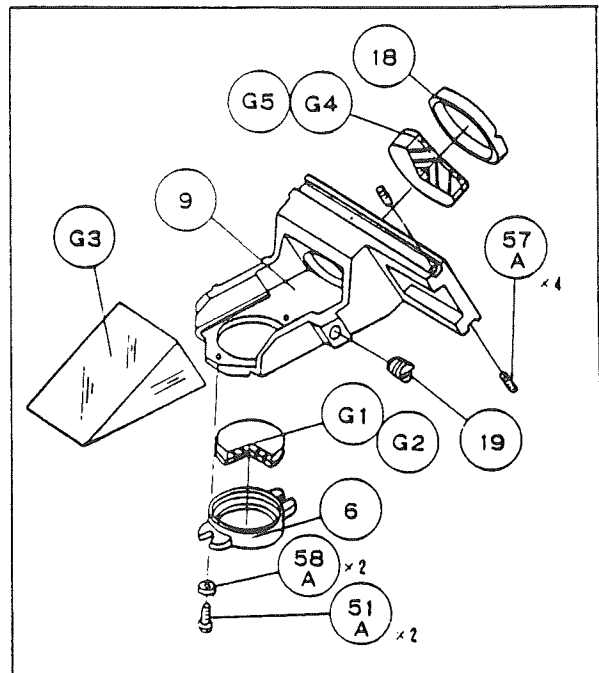


Fig. 22

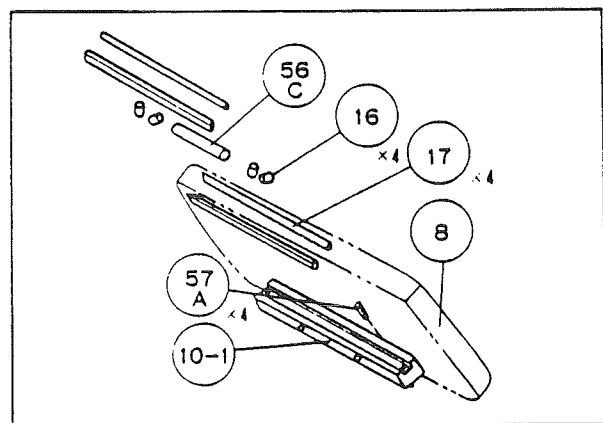


Fig. 23

## REASSEMBLY PROCEDURE

## 2. F-tube

- 7) Fix depression prism (G3) to the roller race with plastic screw (19), transitorily. (After adjustment, stick it using No. 2001) (Fig. 24)
- 8) Attach spring (22) with screws (23) and (54A) × 2 (Stick it to the entire surface of (23), using adhesive No. 921).
- 9) Assemble celluloid washer (21) and optical-path, change-over chamber (2) (containing (7)) into main body (1), and fix them with celluloid washer (14) and retaining ring (13), transitorily.

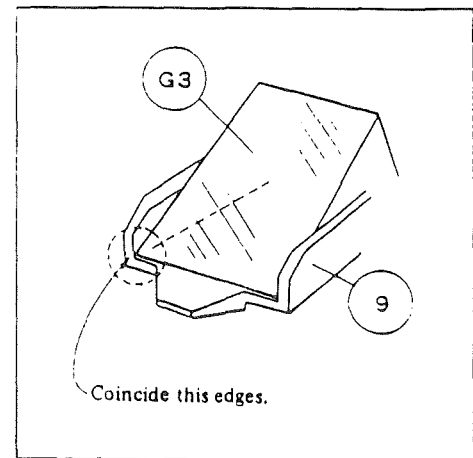


Fig. 24

Drop in click (22) into (7). (Apply oil G7920 to the contact surface of click (7)).

- 10) Attach subassembly (8-1) and (9) to main body (1) with screws (52B) × 4, transitorily. (Fit the notch to the opening of main body (1) at the part to which (8-1) is attached.)
- 11) Insert attaching pin (20) into the groove on the bottom surface of (9). Attach (3) to (2) with screws (52A) × 3. (Apply oil G7920 to the pin)
- 12) Rotating (1), make adjustment of the operation in relation to (2) by means of (13).
- 13) Screw in Photo-tube sleeve (4) onto the top of (2).
- 14) After adjusting the optical axis of depression prism (G3), put Photo-tube (5) over (4) and set it in position with screws (55A) × 3.

## 2-2. Binocular body

Reassemble the body in the same way as for B-tube.

Finally, after making adjustment of the optical axis of the depression prism, attach the binocular body to the depression prism unit with screws (53A) × 3.

## REASSEMBLY PROCEDURE

## 3. UW-tube

## 3. UW-tube

## 3-1. Depression prism unit (Refer to Fig. 3)

- 1) Applying a trifle of adhesive No. 616 to the threaded part of mount (18), screw it into bottom plate (17) (Fig. 25).
- 2) Attach sliding plate (16) and dovetail groove (15) (the one that has not been disassembled) to (17), temporarily.
- 3) Perform the positioning of (15) in respect to (17) as below:

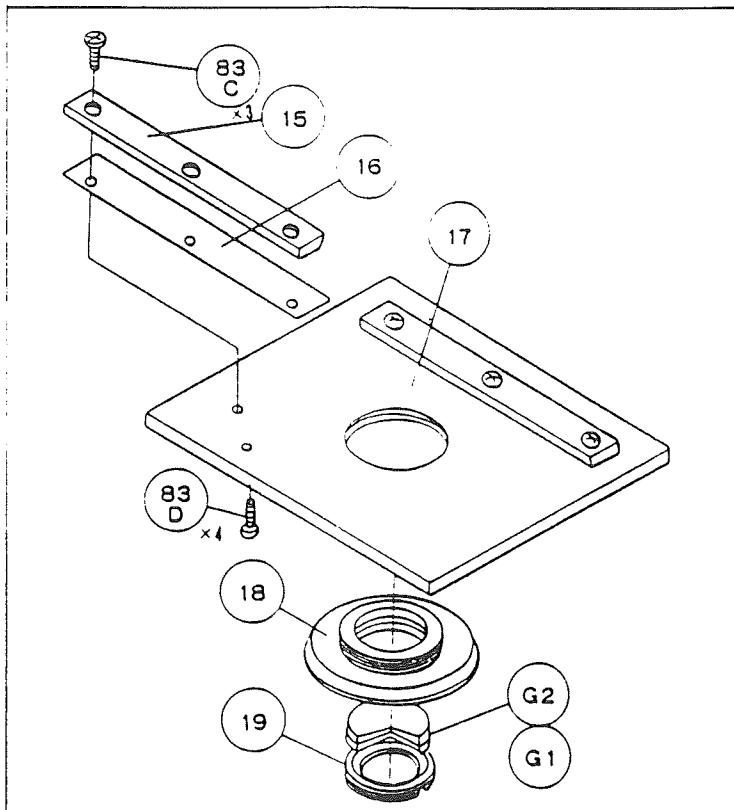


Fig. 25

Insert the male dovetail of prism holder (12) into the fiducial one (has not been disassembled) of (15), and move (15) parallel in the direction of the arrow, as shown in Fig. 26. In this case, keep the slack within about 0.01mm.

- 4) Apply oil G7920 to the sliding surface for dovetail fitting. Check for smooth sliding, and for slow dropping of (17) by itself, when holding (12) with the hand.
- 5) Apply adhesive No. 350 into (93C) x3.

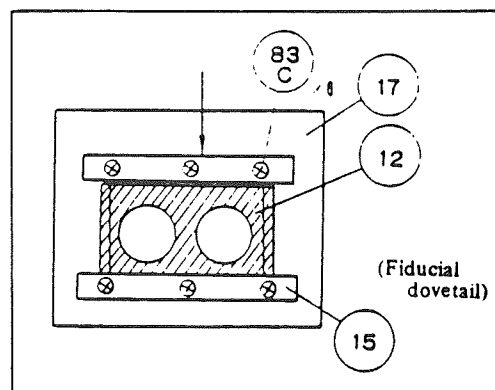
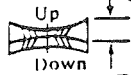


Fig. 26

## REASSEMBLY PROCEDURE

## 3. UW-tube

- 6) Insert lenses (G1) and (G2) into (18), and fix them with retaining ring (19) (to be positioned as  thicker).
- 7) Fix prisms (G3) and (G9) onto dovetail prism holder (12) with plastic screw (11), temporarily in such a position that the bottom edges of prisms coincide with the ends of the walls on both sides, as shown in Fig. 27.

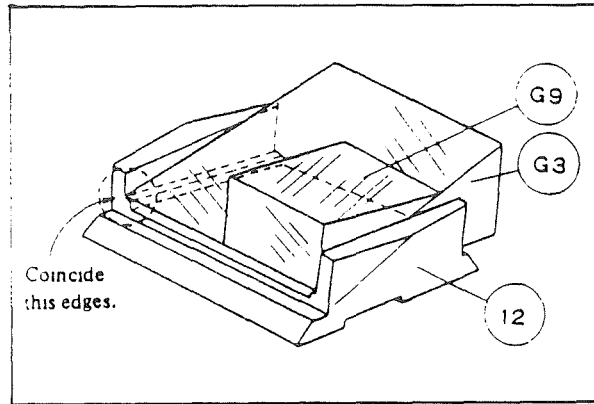
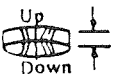


Fig. 27

- 8) Insert lenses (G4) and (G5) (to be positioned as  thicker) into lens chamber (10), applying a trifle of No. 2001 at three points on the stage.
- 9) Fix (10) to main body (9) with screws (83B) x 2 at the center of the hole in (9).

## 3-2. Photo-tube (Refer to Fig. 7)

- 1) Insert lenses (G10) and (G11) into lens chamber (2), and fix them with retaining ring (1).
- 2) Screw in (2) into internal tube (3).
- 3) Screw in (3) into main body (9).
- 4) Screw in sleeve (4) into (3), referring to the mark-off line made at the time of disassembly.  
After adjustment, stick it onto the fitting part of (3) and (4), using No. 350.
- 5) After adjusting the optical axis, attach (5) to (3) with screws (84A) x 3.

## REASSEMBLY PROCEDURE

## 3. UW-tube

## 3-3. Binocular body (Refer to Fig. 9 and 10)

Reassembly procedure is the same as for 1-2. Binocular body (of B-tube), except the following points.

- 1) Apply black paint to the goast prevention groove and the cemented surface of prisms (G6) and (G7)
- 2) For the attaching positions of (G6) and (G7) and righthand prism box (52), refer to Fig. 20.
- 3) For the attaching positions of prism (G6) and lefthand prism box 52, refer to Fig. 21.
- 4) Sticking of righthand sleeve (56) of (G8) is performed as below:

Applying a trifle of No. 2001 all around the upper circumference of (G8), and inserting it into (56), rotate (G8) several times, and leave it 24 hours (Fig. 28).

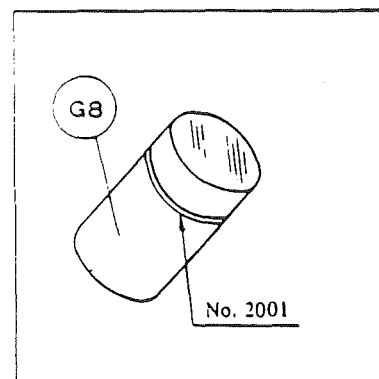


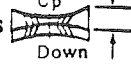
Fig. 28

## REASSEMBLY PROCEDURE

## 4. ER-tube

## 4. ER-tube

4-1. Depression prism unit (Refer to Fig. 11)

- 1) Insert lenses (G1) and (G2) into mount (2) (to be positioned as  thicker) and fix them with retaining ring (3).
- 2) Fix prism (G3) to (2) with plastic screw (4), temporarily, in such a position, as shown in Fig. 29, that the end surfaces are coincided.

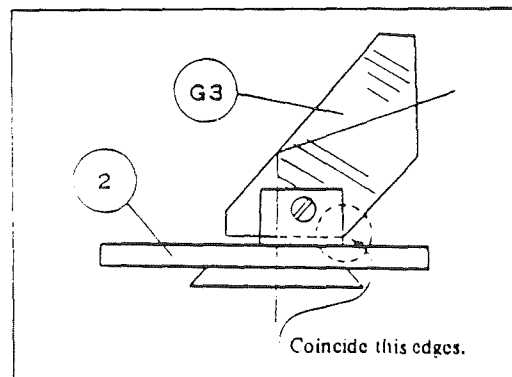
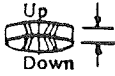


Fig. 29

- 3) Insert lenses (G4) and (G5) (to be positioned as  thicker) into lens chamber (5), and fix them with retaining ring (6).
- 4) Attach (5) to (1) with screws (21A) x 2 at the center of the hole in (5).
- 5) Attach (2) to (1) with screws (21A) x 3.

4-2. Binocular body

- 1-2. Reassembly is the same as mentioned for the binocular body of B-tube.

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**REFERENCE TABLE FOR REPAIR AND ADJUSTMENT**

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**REFERENCE TABLE FOR REPAIR AND ADJUSTMENT**

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**REPAIR AND ADJUSTMENT**

1. Unclear shadows appear in the viewfield during observation
2. Brightness fall-off in the circumference of viewfield

**REPAIR AND ADJUSTMENT (B, F, ER and UW-tube)****1. Unclear Shadows Appear in the Viewfield During Observation**

- Cause: (1) Finger marks, large dust or other dirt remain on the light incidence or exit surface of prism (G3) (G3 and G9) (other part numbers added in parentheses in this way means those used for UW-tube).
- (2) Separation of light reflecting silver layer on the prism.
- (3) Crack in the prism.

**< Repair and Adjustment >**

In the case of (1) ..... Wipe off dirt using a cloth or lens tissue soaked with a trifle of absolute alcohol (ethanol or methanol).

In the case of (2) or (3) ..... Replace the prism.

**Procedure**

- 1) Referring to Disassembly procedure (P.22, 23), disassemble the depression prism unit.
- 2) Clean prism (G3) (G3 and G9).
- 3) For replacement, strike out the prism (G3) (G3 and G9) with a wooden hammer. Stick the new one.
- 4) When replacing, do positioning of the new prism, referring to adjustment (P. 40 ~ 42 and 46).

**2. Brightness Fall-off in the Circumference of Viewfield**

Cause: Incorrect positions of prism (G3) (G3 and G9)

**< Repair and Adjustment >**

Make positional adjustment.

**Procedure**

Refer to the procedure mentioned above in 1.

**REPAIR AND  
ADJUSTMENT****3. 180° Turning of the Tube Causes Movement to the Image in the Center of Viewfield  
4. Not Smooth Operation of Interpupillary Distance Adjustment****3. 180° Turning of the Tube Causes Movement to the Image in the Center of Viewfield.**

Cause, repair and adjustment and procedure are the same as mentioned above in 2.

**4. Not Smooth Operation of Interpupillary Distance Adjustment.**

- Cause: (1) Oil shortage in the central axle.  
 (2) Breakage, deformation or wear of celluloid washers (112) and (113) ((61) and (62) for UW-tube), wave formed base metal (114) ((63)), washer (115) ((64) and flat head screw (142A) ((81A)).

**< Repair and Adjustment >**

In the case of (1) ..... Clear off remnant oil, and apply G7920.

**Procedure**

- 1) Disassemble the binocular body, referring to Disassembly (P. 22 and 23).
- 2) Clean central axle (101) ((51)), celluloid washers (112) and (113) ((61) and (62)), wave-formed base plate (114) ((63)), and washer (115) ((64)).
- 3) Apply G7920 to (101), (112), (113), (114) and (115) ((51), (61), (62), (63), and (64)).
- 4) Perform reassembly, referring to Reassembly Procedure.
- 5) Finally, check for smooth operation of the interpupillary distance adjustment.

In the case of (2) ..... Replace broken, deformed or worn parts among (112), (113), (114), (115) and (142A) ((51), (61), (62), (63) and (64)).

**Procedure**

- 1) Disassemble the binocular body, referring to Disassembly Procedure (P. 22, 23).
- 2) Replace broken, deformed or worn parts among (112), (113), (114), (115) and (142A) ((51), (61), (62), (63), (64)).
- 3) Perform reassembly, referring to Reassembly Procedure.
- 4) Finally, check for smooth operation of interpupillary distance adjustment.

**REPAIR AND  
ADJUSTMENT****5. Interpupillary Distance Changes by Itself**  
**6. Dirt in the Optical System (Flare, Unclear Image of Dust or the Like in the Viewfield)****5. Interpupillary Distance Changes by Itself**

- Cause: (1) Breakage, deformation or wear of wave-formed washer (114) (63).  
(2) Loosening of torque adjusting screw (108) (58).

**< Repair and Adjustment >**

In the case of (1) ..... Refer to 4. Not smooth operation of interpupillary distance adjustment, cause (2).

In the case of (2) ..... Fasten positively the torque adjusting screw (108) (58), so that the torque is 1.5 ~ 2 Kg (Fig. 18).

Note: All the tubes of X and Y microscopes being of Siedentopf type, where the tightness of interpupillary distance adjustment is determined by bending of wave-formed washer (114) (63), the tightness is adjustable by fastening (108) (58).

**Procedure**

- 1) Remove central axle cap (109) (59). Since the screw is attached with No. 350, use alcohol for removal.
- 2) Fasten the torque adjusting screw (108) (58) to make the torque 1.5 ~ 2 Kg.
- 3) Attach central axle cap (109) (59).
- 4) Finally, see that the interpupillary distance does not change by itself.

**6. Dirt in the Optical System (Flare, Unclear Image of Dust or the Like in the Viewfield)**

- Cause: (1) Finger marks, oil or the like on the light incidence surface of prism (G3) (G3) and (G9).  
(2) Large dust on the surfaces of prisms (G6) and (G7) or prism (G8).

**< Repair and Adjustment >**

In the case of (1) ..... Wipe lightly using a cloth or lens tissue soaked with a trifle of absolute alcohol (ethanol or methanol).

**REPAIR AND ADJUSTMENT**

7. Displacement of the Center of Right or Left Viewfield  
 8. Level Difference of Paired Exit Pupils  
 9. Not Smooth Rotation of the Binocular Body (Only in the Case of F-tube)

**Procedure**

Same as in the case of 1. Unclear Shadows Appear in the Viewfield During Observation, cause (1) (P. 35).

In the case of (2) ..... Same as mentioned above in (1), or remove dust using a blower.

**Procedure**

- 1) Disassemble the binocular body of B-tube.
- 2) Clean prisms (G6) and (G7) or (G8).
- 3) Make assembly, following Reassembly Procedure.
- 4) See that no dirt is observed in the optical system.

**7. Displacement of the Center of Right or Left Viewfield.**

Refer to Centering of Viewfield (Adjustment 2-3. P. 45).

For UW-tube, refer to Centering of Viewfield (Adjustment 2-5. P. 45)

**8. Level Difference of Paired Exit Pupils**

Refer to Level Difference (Adjustment 2-6. P.47).

**9. Not Smooth Rotation of the Binocular Body (Only in the Case of F-tube).**

- Cause: (1) Breakage, deformation or slack of plate spring (22).  
 (2) Breakage, deformation or oil shortage of celluloid washer (14) or (21).

**< Repair and Adjustment >**

In the case of (1) ..... If plate spring (22) is found broken or deformed, make replacement.

If slag takes place, fasten up screws (54) x2, tightly.

**Procedure**

- 1) Disassemble the depression prism unit of F-tube.
- 2) Make Repair and adjustment, mentioned above.
- 3) Make assembly, referring to Assembly Procedure.
- 4) Finally, check for smooth rotation of the binocular body.

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**REPAIR AND ADJUSTMENT**

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**9. Not Smooth Rotation of the Binocular Body  
(Only in the Case of F-tube)**

In the case of (2) If celluloid washer (14) or (21) is found broken or deformed, make replacement. In the case of oil shortage, apply L4010.

**Procedure**

- 1) Disassemble the depression prism unit of F-tube.
- 2) Make the adjustment mentioned above.
- 3) Perform reassembly, referring to Reassembly Procedure.
- 4) Finally, check for smooth revolution of the binocular body.

## ADJUSTMENT

## 1. Depression Prism Unit

1-1. Adjustment of optical axis (rotation axis of the tube).

First, proceed to the optical axis adjustment of only the depression prism unit, and then, after attaching the binocular body, make final adjustment by means of prisms (G1) and (G2) for B-tube and F-tube or lenses (G4) and (G5) for ER-tube and UW-tube, as follows:

- 1) Attach standard straight tube and Kellner eyepiece (J28006) to the tube of microscope (X, Y or S) and place the test plate (check pattern micrometer) on the stage, coinciding the center of the test plate to that of the eyepiece viewfield, using 10X objective.
- 2) Remove the standard straight tube (do not move the test plate), and attach the depression prism to the microscope.
- 3) Pushing the specific straight tube (provided with Kellner eyepiece) against the depression prism unit with the hand, see a displacement of the center of the test plate from that of the eyepiece viewfield. If the displacement is found within a range of 5 scale lines, it will be possible by attaching the binocular tube, and moving the center of the viewfield, to adjust the rotation axis.

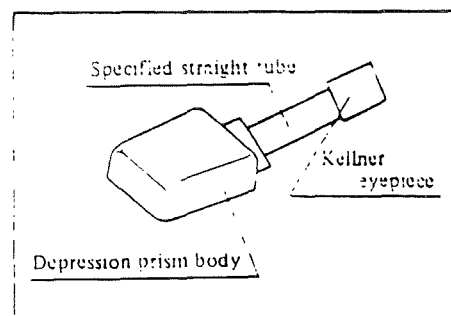


Fig. 30

## &lt; In the Case of a Larger Displacement of the Center &gt;

**(B-tube)**

- 1) Moving lens chamber (3) (with (G1) and (G2) inside) make the displacement within a range of 5 scale lines in the Kellner eyepiece. It is desirable to keep lens chamber (3) at the center of the hole.

## ADJUSTMENT

## 1. Depression Prism Unit

- 2) If, in this case, such a center displacement cannot be corrected by moving the lens chamber ③, make adjustment of prism ③, as below:
- For lateral adjustment, place a piece of silver foil (0.1mm thick) underneath, as shown in Fig. 31, to cause a movement corresponding to 5 scale lines.
  - For vertical adjustment, move prism ③ along the wall of prism mount ②, as shown in Fig. 31.

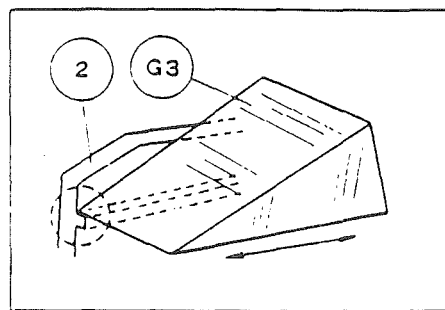


Fig. 31

**(F-tube)**

- Moving lens chamber ⑥ (with G1 and G2 inside), make the displacement within a range of 2 scale lines in the Kellner eyepiece.
- If the center displacement cannot be corrected by moving chamber ⑥, make adjustment of prism ③, as below:

Place a piece of silver foil (0.1mm thick) underneath, as shown in Fig. 32, to cause a movement corresponding to 5 lines.

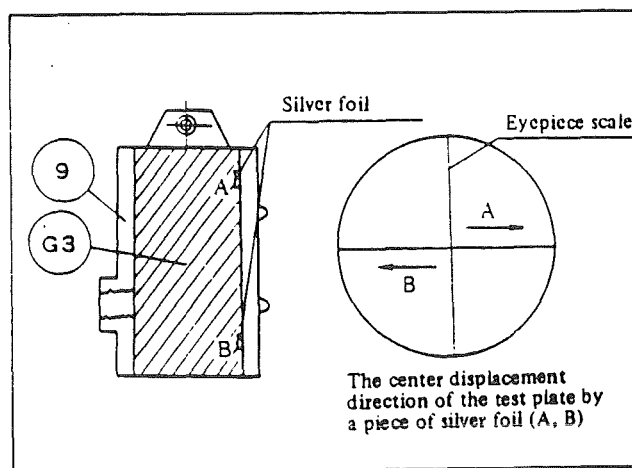


Fig. 32

## ADJUSTMENT

## 1. Depression Prism Unit

## (ER-tube)

- 1) Moving lens chamber (5) (G4) and (G5) inside), make the displacement within a range of 2 lines in the Kellner eyepiece.
- 2) If the center displacement cannot be corrected by moving chamber (5), make adjustment of prism (G3) as below:

## a) Vertical direction

As shown in Fig. 32, insert pieces of silver foil (0.05mm thick) at A and B, to cause the movement corresponding to about 10 lines.

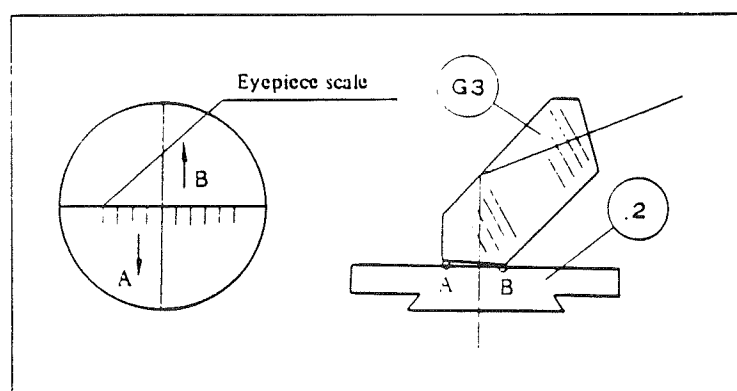


Fig. 33

## b) Lateral direction

As shown in Fig. 33, insert pieces of silver foil (0.1mm thick) at C and D, to cause the movement corresponding to about 10 lines.

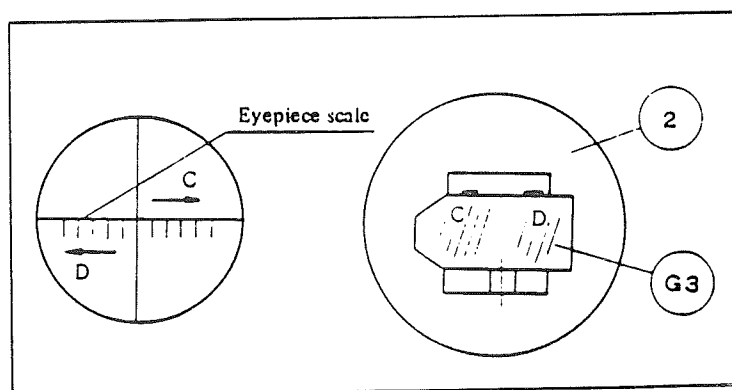


Fig. 34

- 3) After adjustment, fasten (G3) with plastic screw and apply No. 2001 and No. 350.



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**ADJUSTMENT**

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**1. Depression Prism Unit**

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(UW-tube)

- 1) Moving lens chamber (10) (with (G4) and (G5) inside), make the displacement within 2 scale lines in the Kellner eyepiece.
- 2) If the center displacement cannot be corrected by moving chamber (10), make adjustment of prisms (G3) and (G9).

The adjusting procedure is the same as that for B-tube (P. 41).

## ADJUSTMENT

## 2. Binocular Body

## 2. Binocular Body

Follow the same procedure for B-tube, F-tube, ER-tube and UW-tube.

To the depression prism unit, whose adjustment has been completed, attach central axle (101) (51) for UW-tube).

## 2-1. Positioning of prisms (G6) and (G7)

- 1) Insert the crosshair eyepiece into lefteye sleeve (105) (55), and move the test plate to bring its center into coincidence with the center of crosshair.
- 2) Move the righteye tube.
- 3) See the displacement of the test plate image in the lefthand eyepiece.
- 4) No displacement will take place, so far as the prisms are in the specified positions.
- 5) If the image moves vertically, raise prisms (G6) and (G7) in the direction of the arrow in Fig. 34.
- 6) The movement is to be within a half division of the lines on the test plate.
- 7) If a lateral displacement is over one division, replace prisms (G6) and (G7).
- 8) Tighten plastic set screw (110) (11), using a wooden handle screw driver

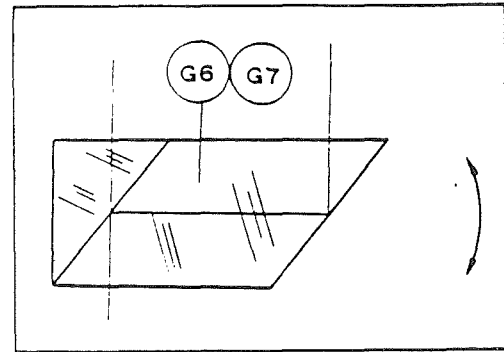


Fig. 35

## 2-2. Adjustment of righteye interpupillary distance changing axle

- 1) Insert the crosshair eyepiece into the righteye sleeve, and bring the center of the crosshair into coincidence with that of the test plate.
- 2) Moving the righthand tube, change the position of sleeve metal (106) (56) (with eyepiece) to bring the center of the crosshair to the position, where the image does not move.
- 3) Lock screw (143A) (83D).

## ADJUSTMENT

## 2. Binocular Body

## 2-3. Viewfield center adjustment

- 1) Moving the test plate, bring its center into coincidence with the scale center of the right side Kellner eyepiece.
- 2) Move the Kellner eyepiece from the right to the left eye sleeve, and change the position of sleeve metal (105) (55) to bring the eyepiece scale center into coincidence with the test plate center. The displacement should be 0.0 outside, within 0.2mm inside, and 0.1mm vertically on the focal plane of eyepiece.
- 3) With the max. and min. interpupillary distance, make the displacement within the above specified values. Jumping of the axle at the limits is caused by the slack of metal (requiring the replacement).
- 4) Apply No. 350 to screw (143A) (83), used for attaching eyepiece sleeves (105) and (106) (55) and (56).

## 2-4. Rotation axle

Set the interpupillary distance to 64mm. Bring the center scale in the Kellner eyepiece into coincidence with that of the test plate, and rotate the tube  $180^\circ$ . At this time, the center displacement should be within 0.2mm (both for the right and left) on the focal plane of eyepiece.

## (B-tube)

- 1) Keeping the retaining ring (4) fastened, move the metal containing (G1) and (G2) a half of the movement of the rotating axle, as shown in Fig. 27, for coincidence.
- 2) Apply No. 350 to stick mount (2), lens chamber (3) and retaining ring (4).

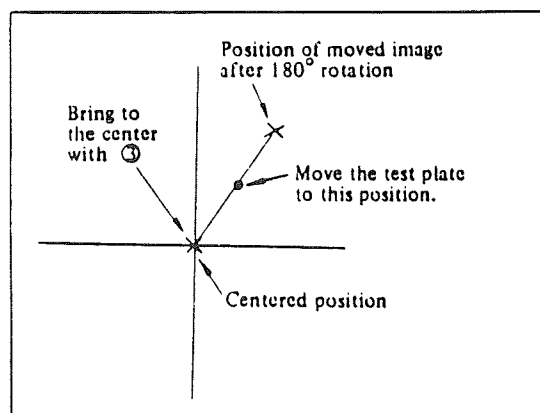


Fig. 36

## ADJUSTMENT

## 2. Binocular Body

**(ER-tube)**

- 1) Unscrew (22A), and remove the binocular body. Release screw (21A) to move lens chamber (5) (with (G4) and (G5) inside). Attach the binocular body to the main body again holding this with the hand.

See that no derangement takes place (For adjustment, consider such a derangement as caused by fastening (22A)).

- 2) Apply No. 350 to screw (21A).
- 3) Fix the binocular body to the main body (1) with screws (22A) x 3.

**(F-tube)**

- 1) Fasten screw (51A) lightly, and move lens chamber (6) (with (G1) and (G2) inside). Attach the binocular body to the main body again holding this with the hand to see that no derangement takes place.
- 2) Lock (51A) ((6)), applying No. 350.
- 3) Fix the binocular body to the main body (1) with screws (53A) x 3.

**(UW-tube)**

- 1) Place the straight tube (tool) on the binocular tube attaching part, pushing the tool tube sufficiently against the main body. Make adjustment by moving (10) (with (G4) and (G5) metals inside) within a range of 2 scale lines in the Kellner eyepiece. (If an attaching error of optical axis of binocular body is found, make adjustment for (10), once again.)

**2-5. Parfocality adjustment**

- 1) After focusing in the standard straight tube, take reading of the dial gauge to measure the tube length error ( $115.2 \pm 1\text{mm}$ ), using tool J25148 for adjusting tube length.
- 2) Moving vertically the sleeve cover ring (107) ((57)), bring the above mentioned error within  $\pm 0.1\text{mm}$ .
- 3) If in the above case, level difference of paired exit pupils is found within 0.5mm between the right and left ends, OK.

## 2-6. Level difference of paired exit pupils

- 1) If in 2-5, 3), the level difference is found over 0.5mm, raise or lower  $\textcircled{G6}$  in the direction of the arrow, as shown in Fig. 37.

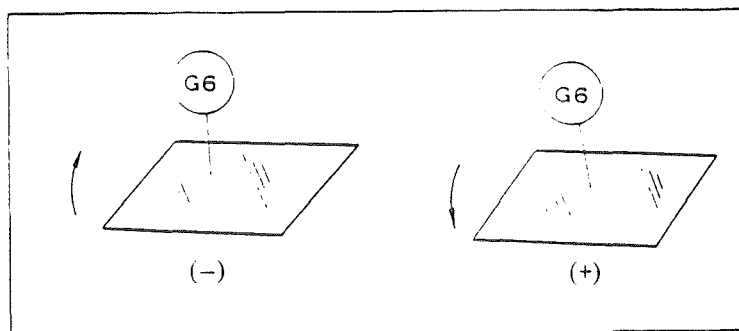


Fig. 37

- 2) After the adjustment of  $\textcircled{G6}$  has been completed, check at all times for the correct adjustments mentioned in 2-3, 2-4 and 2-5.

2-7. Finally, lock prisms  $\textcircled{G6}$  and  $\textcircled{G7}$  in position using adhesive.

## 2-8. Focus adjustment of Photo-tube (UW-tube)

- 1) Insert the parfocality adjusting mirror (tool) into photo-tube sleeve  $\textcircled{4}$ .
- 2) Setting the autocollimator to infinity, perform infinity checking, using the above mentioned mirror.
- 3) If not adjusted to infinity, turn  $\textcircled{4}$  in relation to photo-tube  $\textcircled{3}$ .
- 4) Apply screw lock to  $\textcircled{3}$  and  $\textcircled{4}$ , and leave them in their adjusted positions until the lock sets, to avoid parfocality derangement caused by screw slack.

10

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