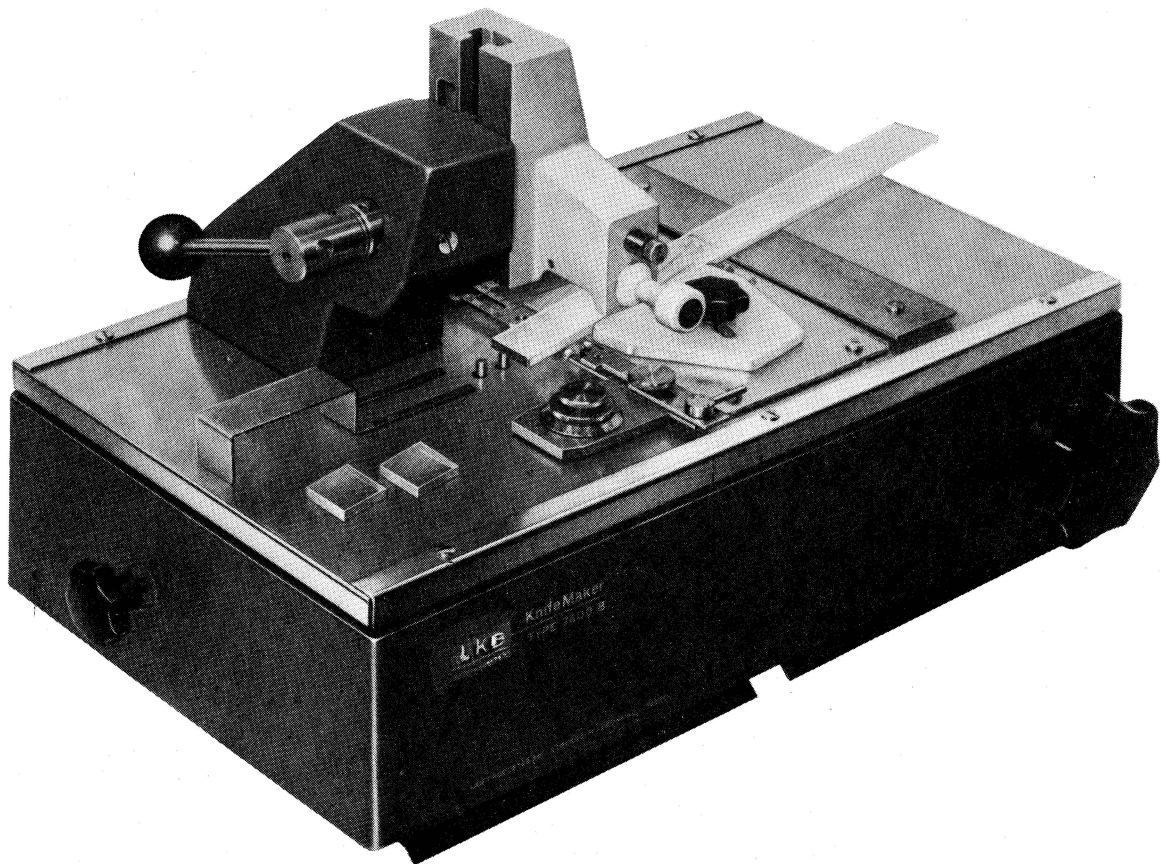


KNIFEMAKER 7800 B



I. INTRODUCTION

Glass knives for ultramicrotomy are made from sheet glass supplied in selected strips of preferably 25 or 38 mm width, (see V. SPARE PARTS and SUPPLIES). After being cleaned in a detergent, e.g. Teepol, the strips are scored transversely in the KnifeMaker and broken off into a number of squares or rhombi, sufficient for current needs. The glass pieces are inserted in the KnifeMaker where they are scored diagonally and broken into two pieces one of which has a straight and sharp edge of high quality, provided the recommended glass quality is used and the following instructions are carefully followed.

II. OPERATING

SCORING ANGLE AND ACTUAL EDGE ANGLE

(see fig. 2)

In breaking knives one must be careful to distinguish between the scoring angle (δ) — the angle subtended by the score and the strip side (s) — and the actual edge angle (α), that is the angle between the strip side (s) and the tangent to that part of the fracture (sectioning facette) which is active during cutting. By careful location of the score line in reference to the corner, it is possible to keep the difference between the scoring angle (δ) and the edge angle (α) within reasonable limits (say 5—15°). It is simplest to let the knife edge be formed as shown in the figure, but some operators try to "hit the corner" in which case the knife edge may be formed on any side of the corner. There are advantages and disadvantages with both methods which cannot be discussed in detail here. However, the former procedure is adopted here, although it is easy to set the apparatus to follow the latter method whenever desired.

For sake of simplicity the instructions below first deal in some detail with the procedure of making knives from glass squares. The operator should first familiarize himself with the technique of using squares before starting to make knives from rhombi (diamond shaped pieces). The procedure is essentially the same but for location of score lines.

MAKING KNIVES FROM SQUARES

(45° scoring angle)

A. Preparing the apparatus for making squares (see fig. 1):

1. Swing locking lever (2) to rear position.
2. Check that scoring shaft (15) is fully pushed in.
3. Set symbol \equiv on score selector (13) upwards.
4. Loosen screws (9) and (23) and push the two glass holders (22) and (28) to their outermost positions.

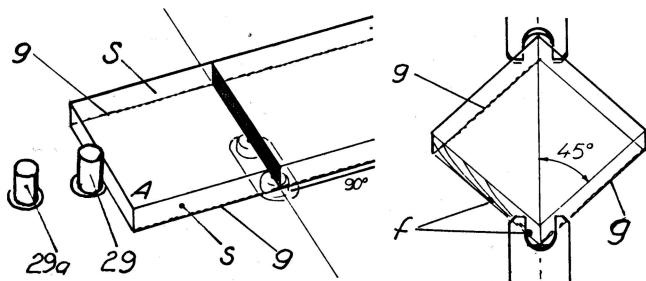
NOTE: When using 38 mm glass strips turn disengage knob (31) backwards and pull it outwards to stop.

5. Turn breaking knob (18) counter-clockwise to stop.

NOTE: It is recommended to cut the glass strips supplied (length 400 mm) in half when using them in the KnifeMaker. A too long (heavy) strip will not be clamped properly and squares or rhombi produced may in such case have misshaped corners which are unsuitable for knife production.

When cutting the strips in half proceed as follows:

- a) See steps 1 and 2 in B. below.
- b) Press glass strip against guide plate (21) and lift the left part of strip over the studs (29), (29a) and push simultaneously the strip to the left until the right end of strip comes above dot (14a).
- c) See steps 5, 6, 7, 9, 10, 11, and 12 in B. below.
- d) Remove the two glass strips.
- e) Proceed with section B. below.



B. Making squares (see fig. 1):

1. Set guide plate (21) at 90° line.
CAUTION: With all handling of glass strips be sure not to touch the sides (s) with the fingers.
2. Place glass strip in apparatus with scoring edges (g) of strip turned downwards as shown in figure above. Make sure that

no glass splinters or other litter lies under the glass strip and support plate (16).

3. Press glass strip against guide plate (21) and push strip to the left until it stops against arresting stud (29), see figure above. **Do not remove the hand.**
(When using 38 mm glass strips it may be convenient to keep stud (29) depressed by means of adhesive tape before step 3 is carried out.)
4. Push front glass holder (22) until it touches glass strip, then tighten locking screw (23).
5. Lower clamping head (8) with lever (2) (while still holding glass strip) until it touches the strip.
6. **Remove the hand.**
7. Press lever (2) firmly downwards to locking position. However, do not use undue force.
8. Place fork (1) under end of glass strip.
9. Scoring. Pull out scoring shaft (15) to its stop.
10. Breaking. Turn knob (18) clockwise until the glass fractures and then reset the knob.
11. Support scoring shaft with the right hand while moving lever (2) to its starting position to prevent clamping head (8) from causing damage to glass parts.
12. Push in scoring shaft fully.
13. Remove glass square by means of fork.
14. Repeat steps 3—13 until required number of squares are obtained.

C. Preparing the apparatus for making knives (see fig. 3):

1. Swing lever (23a) to the position shown in fig. 3 (damper (23b) retracted). Loosen locking screw (23) and set glass holder (22) to 10, then lock holder. For 38 mm strips set to 18. If these settings do not give proper length of "y", read step 15 below.
2. Loosen screws (11) and (24) and set black dot on dials (12) and (25) at index line. Tighten the screws.

NOTE: Before placing square in apparatus, read carefully "NOTE: For location" under D. below.

3. Place a glass square in apparatus so that its corner A faces operator.
4. Check that disengage knob (31), (see fig. 1) is fully pushed in.
5. Push rear glass holder (28) against glass square.
6. Turn knob (31) slowly backwards and pull it outwards to stop.
7. Push rear glass holder (28) two scale divisions towards glass square. Then lock holder with screw (9).
8. Push in disengage knob (31). Glass holder (28) will then press against glass square.
9. Check that scoring shaft is in rearmost position.
10. Set score selector (13) (see fig. 4) with "25" upwards.

NOTE: For 38 mm glass strips use setting "38".

11. Lower clamping head (8) by means of lever (2) and lock it by pressing firmly downwards. However, do not use undue force.
12. Make the score. (*This is a test score.*) Do not break the square.
13. Support scoring shaft with the right hand while moving lever (2) to its starting position.
14. Push in scoring shaft fully.
15. Turn knob (31) backwards and remove glass square. Check that the position of the score is located as shown in fig. 5. Distance "y" in fig. 5 should be 1—2 mm. If larger, glass holder (22) should be pushed in a distance equal to the correction needed and rear holder (28) should be moved in the same direction an equal amount. If smaller, see Example below.
(Example: If "y" is 0.5 mm move holder (22) outwards 1 mm, i.e., new setting is now 11 on holder scale.) This setting should be noted as reference setting for all future work with 25 mm glass squares.
The score line is now directed towards corner A. As mentioned above, one usually prefers to form the edge to the right of corner A as shown in fig. 2, by moving the corner to the left so that the score line hits the edge of the square a small distance "c₁" from the corner, see fig. 2 or 6. The actual fracture meets strip side (s) a distance "c₂" from the corner which is larger than "c₁". By keeping "y" and "c₁", see figs. 5 and 6, within certain limits, "c₂" is easily controlled. Usually one prefers to keep "c₂" below 0.5 mm which means that "c₁" should be less than that.
16. Loosen locking screw (24) and turn dial (25) counterclockwise five scale divisions. If C₂ is too large, turn dial (25) clockwise. Tighten screw (24).
17. Adjust rear glass holder by turning dial (12) counterclockwise until the score runs symmetrically over the square, i.e., until "c₃", see fig. 6, is approx. equal to "c₁".

D. Making knives:

It is of paramount importance that the squares or rhombi are kept clean and handled carefully.

NOTE: For location of the squares note that the two fractured "transverse" sides of each square have a more or less conchoidal surface (a), see fig. 3. Most of the lines (e) seem to radiate from the two points (f) on lower edge of surface where the breaking pins were in contact with the glass. This side should be turned to the left. Procedure when using squares:

1. Place a square in apparatus as described above so that corner A nearest the contact marks (f) is directed towards operator. (The opposite corner is usually not as straight and symmetrical as the corner nearest to the contact marks and is therefore not used. If knife edge disturbances occur, put a piece of adhesive tape on underside of the glass square without touching corner A (see fig. 3). Also check that damping pad (23 b) is free from glass splinters.
 2. Push in scoring shaft fully.
 3. Turn breaking knob counter-clockwise to stop.
 4. Put fork in under glass square, see fig. 7.
 5. Lower clamping head (8) with the lever, see fig. 4, to locking position. (Do not use undue force when locking.)
 6. Make the score.
 7. Move DPA-lever (23 a) until damping pad touches glass.
 8. Break by turning knob (18) clockwise until glass fractures and then reset knob.
 9. Reset DPA-lever to position shown in fig. 3.
 10. Support scoring shaft with the right hand while moving lever (2) to its starting position.
 11. Push in scoring shaft fully.
 12. Turn disengage knob (31) backwards, see fig. 1, and pull it outwards to stop.
 13. Remove the two glass pieces by means of fork. (14. Peel off tape by pulling at left hand part as shown in fig. 3 a.)
- Regarding factors influencing knife properties, see section "A Few Hints for Better Glass Knives" below.

MAKING KNIVES FROM RHOMBI

Rhombi are used when it is necessary to make knives having edge angles which are smaller or larger than those obtained by using squares. Though the KnifeMaker has been provided with guidelines for producing rhombi with corner angles $70^\circ/110^\circ$, and $80^\circ/100^\circ$ respectively, intermediate angles are readily obtained by using the unmarked guide lines, see fig. in III. C. The scoring angles are half the corner angles (i.e., 35° , 55° , 40° , 50°). The procedure of making knives is essentially the same as given above but the orientation of the score lines is different depending upon which corner is intended to be used. (See Table 1 where score lines (g) and contact marks (f) are indicated.)

E. Procedure for making knives with scoring angles less than 45° ($35^\circ-45^\circ$)

Use acute angles of rhombi e.g., 70° or 80° as shown in Table 1. Making rhombi. The scoring procedure described in II. A and II. B may in principle be adopted, i.e., the guide plate (21) is set to an angle equal to twice the scoring angle intended.

Making knives: Follows instructions given in sections II. C and II. D. (see also Table 1).

NOTE: Distance "y" will be longer compared with "y" on 45° knives.

If the edges become misshaped, it is recommended to reduce the scoring pressure and/or c_2 , see fig. 2.

F. Procedure for making knives with scoring angles larger than 45° ($45^\circ-55^\circ$)

Use obtuse angles of rhombi e.g., 100° or 110° as shown in Table 1. Follow procedure which is described above. Note the different orientation of score lines (g) and contact marks (f). Note proper setting of glass holders (22) and (28), see Table 1. Distance "y" may be less than 1 mm.

A FEW HINTS FOR BETTER GLASS KNIVES

Valid for glass recommended by LKB

i) Glass squares and rhombi

Flatness and orientation of fracture surface are influenced by the scoring pressure. It is often an advantage to use a small scoring pressure.

ii) Glass knives

To obtain optimal usable knife edge (z):

- a) increase scoring angle (δ) (if advisable for other reasons)
- b) do not operate with too great scoring pressure.
- c) keep distance c_2 below 0.5 mm. But it should be considered that the durability of knife edge decreases since actual edge angle decreases with c_2 .

CAUTION: Do not use glass knives which are thinner than 5 mm ($7/32''$) since usable edge length decreases with glass thickness. The damper (23b) increases the useful length of knife edge considerably if it is in good condition and is properly applied. When damping pad is worn, damping effect may be reduced and scattered rubber fragments may appear on the knife edge. Then the pad (23b) should be turned slightly or eventually replaced after extensive use.

III. SERVICING

A. ADJUSTMENT OF SCORING PRESSURE

(see fig. 8)

If the score in the glass becomes too deep or too faint, the pressure on the cutter wheel must be adjusted as follows:

1. Remove clamping head (8) as follows:
 - a) Set lever (2) at about 45° angle as shown in fig. 4.
 - b) Set symbol \equiv on score selector (13) upwards,
 - c) Remove clamping head and place it upside down on a table.
2. Insert Allen wrench (39) into screw (33) and adjust spring pressure as follows:
 - a) If scoring pressure is too great, turn wrench counter-clockwise e.g., one turn.
 - b) If scoring pressure is too small, turn wrench clockwise e.g., one turn.
3. Replace clamping head (8) as follows (See fig. 4):
 - a) Check that locking lever (2) is at about 45° .
 - b) Press shaft (3) to the right with left hand and push simultaneously down clamping head (8) into bracket (5) with the right hand.
4. Make a test scoring.

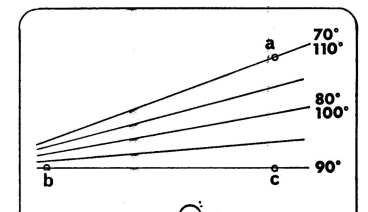
B. REPLACEMENT OF CUTTER WHEEL

Since dimensions and cutting properties of cutter wheels are of vital importance, it is recommended to use replacement wheels supplied by LKB.

1. Remove clamping head (8) see step 1 in III. A.
2. Pull out scoring shaft (15) about 40 mm.
3. Hold clamping head as shown in fig. 8 and press down holder (32) of cutter wheel with thumb and remove locking pin (36). (If it is difficult to press down the holder (32) loosen screw (33) by turning it counter-clockwise).
4. Place clamping head (8) on table and push out cutter wheel's shaft (35) with e.g., a paper clip and remove wheel (34).
5. Insert new cutter wheel and new shaft.
6. Replace pin (36).
7. Replace clamping head (8), see step 3 in III. A.

C. REPLACEMENT OF ANGLE SETTING PLATE

1. Remove locking knob (17), guide plate (21), screws (40) and angle setting plate (20), see fig. 1.
2. Apply new setting plate and insert the two screws but do not tighten them yet.
3. Adjust the plate so that the lines $70^\circ/110^\circ$ and 90° coincide with the dots, a, b and c.
4. Tighten the screws.
5. Replace guide plate (21) and knob (17).



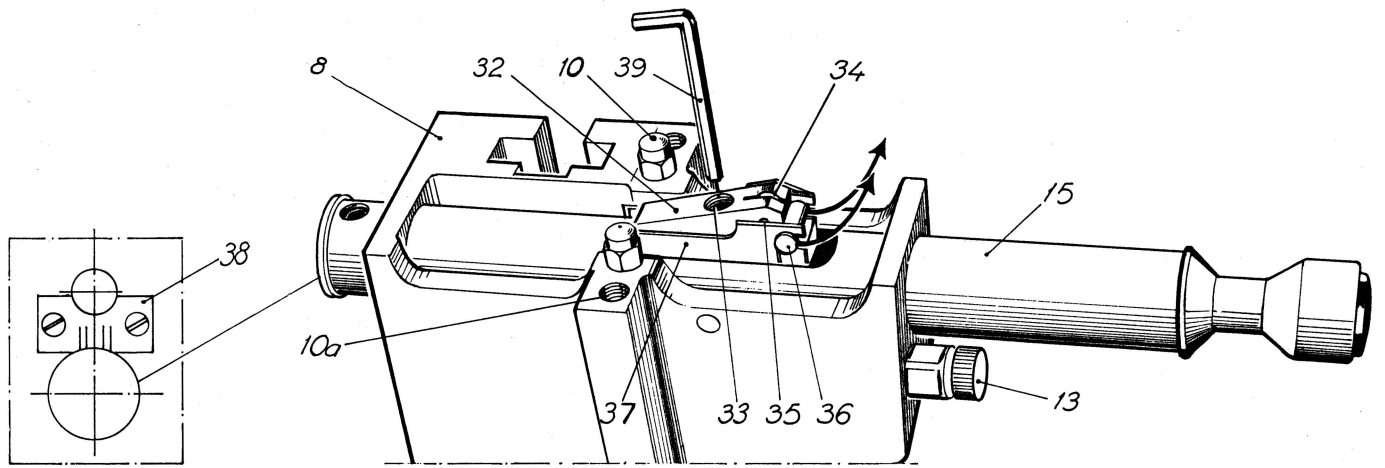


Fig. 8

Nominal edge angle	35°	40°	45°	50°	55°
Corner angle	70°	80°		100°	110°
Angular setting of guide plate (21) for strip scoring	$\left\{ \begin{array}{l} 70^\circ \\ 110^\circ \end{array} \right.$	$\left\{ \begin{array}{l} 80^\circ \\ 100^\circ \end{array} \right.$	use squares	$\left\{ \begin{array}{l} 80^\circ \\ 100^\circ \end{array} \right.$	$\left\{ \begin{array}{l} 70^\circ \\ 110^\circ \end{array} \right.$
Orientation of strips for scoring and breaking					
Orientation of rhombi for scoring and breaking					
Nominal settings of the glass holders (22) and (28)	25 mm strip				
	front (22) rear (28)	10 See sect. C steps 4-8	10 See sect. C steps 4-8	11 See sect. C steps 4-8	11 See sect. C steps 4-8
	38 mm strip				
	front (22) rear (28)	18 See sect. C steps 4-8	18 See sect. C steps 4-8	19 See sect. C steps 4-8	19 See sect. C steps 4-8

TABLE 1

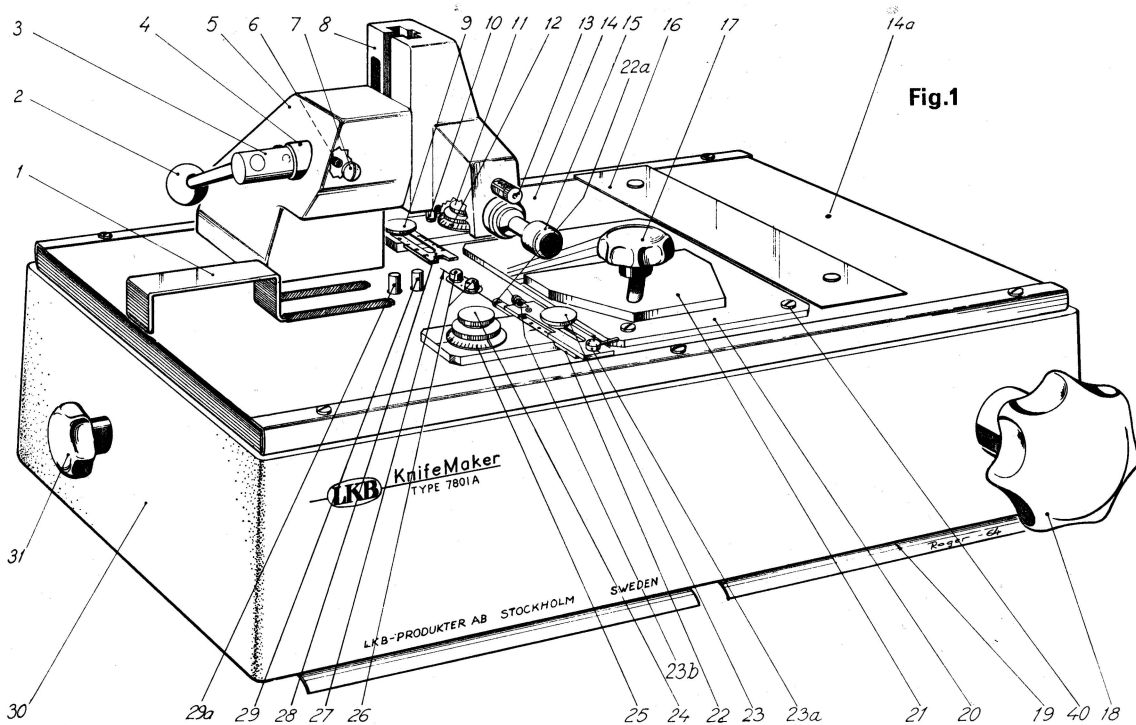


Fig.1

- | | | |
|--|----------------------------|--|
| 1. Fork used to remove the glass knives from the apparatus | 7. Cover screw for (6) | 14a. Dot (marking 200 mm strip length) |
| 2. Locking lever | 8. Clamping head | 15. Scoring shaft with cutter wheel |
| 3. Shaft | 9. Locking screw for (28) | 16. Support plate for glass strip |
| 4. Adjusting sleeve for (8) | 10. Support studs | 17. Locking knob for (21) |
| 5. Bracket | 11. Locking screw for (12) | 18. Breaking knob |
| 6. Set screw for (4) | 12. Rear dial | 19. Operation Instructions |
| | 13. Score selector | 20. Angle setting plate |
| | 14. Cover plate | 21. Guide plate |
| | | 22. Front glass holder |
| | | 22a. Guiding rings |
| | | 23. Locking screw for (22) |
| | | 23a. DPA-lever (lever for Damping Pressure Adjustment) |
| | | 23b. Damping pad |
| | | 24. Locking screw for (25) |
| | | 25. Front dial |
| | | 26. Breaking pins |
| | | 27. Centre line |
| | | 28. Rear glass holder |
| | | 29. Arresting stud for 25 mm glass strips width |
| | | 29a. Arresting stud for 38 mm glass strips width |
| | | 30. Foundation block (silumin-gamma) |
| | | 31. Disengage knob |
| | | 32. Cutter wheel holder (see fig. 8). |
| | | 33. Screw for adjusting scoring pressure |
| | | 34. Cutter wheel (sintered tungsten carbide) |
| | | 35. Shaft for cutter wheel |
| | | 36. Locking pin |
| | | 37. Bracket for (32) |
| | | 38. Guide for (15) |
| | | 39. Allen wrench for adjusting scoring pressure |
| | | 40. Screws for (20) |

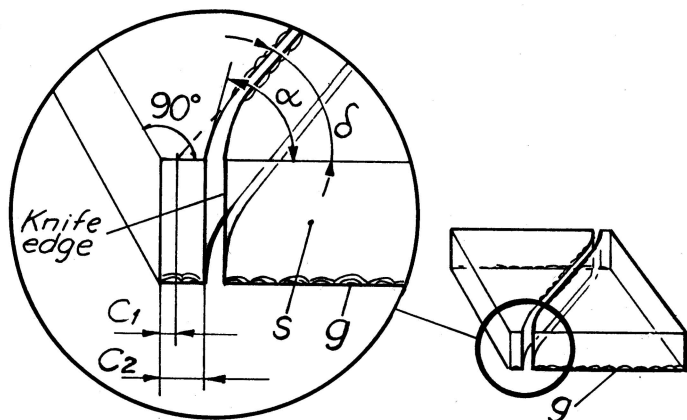


Fig. 2

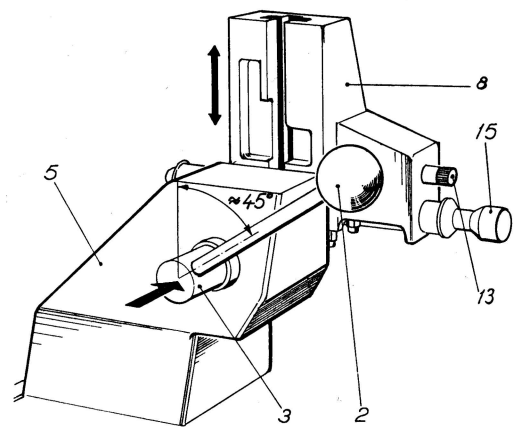


Fig. 4

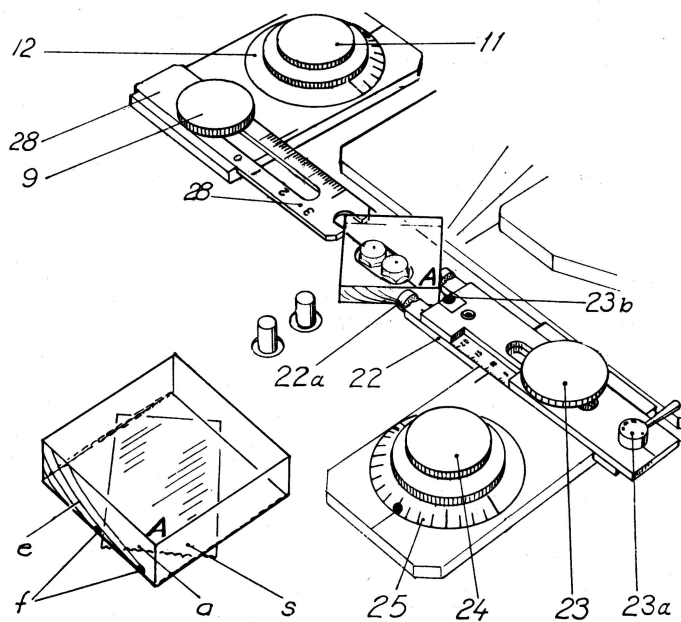


Fig. 3

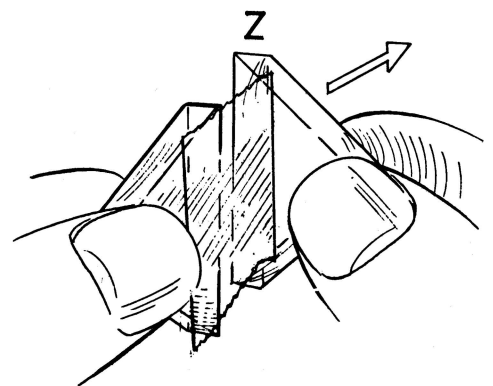


Fig. 3a

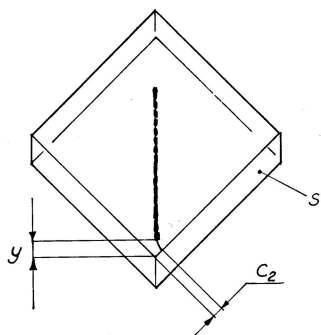


Fig. 5

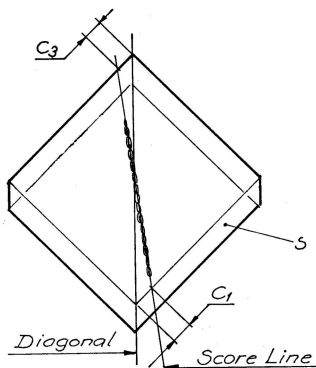


Fig. 6

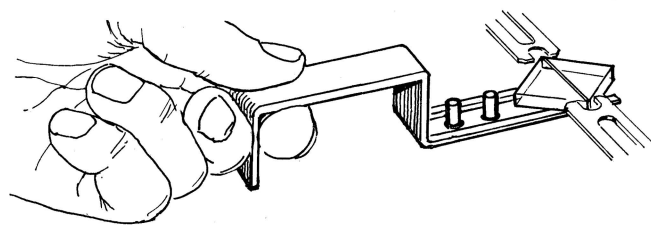


Fig. 7

IV. TROUBLE-SHOOTING

FAULT	POSSIBLE CAUSE	REMEDY
1. Strip moves while scoring.	<ul style="list-style-type: none"> a) Clamping of strip impaired by hand force. b) Too heavy (long) strip. c) Foreign matter underneath support plate (16) and/or glass strip. 	<ul style="list-style-type: none"> a) See section II. B., steps 5—7. b) Use shorter strip. 200 mm strip length recommended. Use dot (14 a) see fig. 1, as a guide for halving 400 mm strip. c) Remove glass splinters or other litter from top surface of apparatus.
2. Squares or rhombi have misshaped corners.	<ul style="list-style-type: none"> a) Glass strip not securely clamped. b) Too great or too small scoring pressure. c) At 70° rhombus: Front end of score too close to strip side. 	<ul style="list-style-type: none"> a) See section II. step B. 7. Apply extra force on locking lever (2). b) Adjust scoring pressure. See section III. A. c) Retract guide plate (21) about 2 mm.
3. Knife has misshaped edge.	<ul style="list-style-type: none"> a) Knife edge is formed at misshaped corner. b) Distance (y), see fig. 5, is too small. c) Distance (c₂), see fig. 2, is too large (score angles 35°—45°) or too small (score angles 50°—55°). d) Upper studs (10) too close to edge of glass. 	<ul style="list-style-type: none"> a) See IV. 2. above. b) Adjust (y). See section II. C. steps 1 and 15. c) Adjust (c₂). See section II. C., steps 15 and 16.
Edge is skew.	<ul style="list-style-type: none"> e) At 35° knives: Distance (c₂), see fig. 2, is too large. f) Scoring pressure is too high. g) Top of damping pad is protruding too much above its holder. 	<ul style="list-style-type: none"> d) Check width of glass (min. 24.8 mm). If in order, set front glass holder (22) half a division lower e.g., from 10.5 to 10. e) Reduce (c₂). See section II. C., steps 15 and 16. f) Reduce scoring pressure. g) Push down pad until top is in level with surface of holder.
4. Fractures occurs while scoring.	<ul style="list-style-type: none"> a) Too great scoring pressure. b) Clamping head (8), see fig. 1, is pushed down by hand while locking. c) Glass strip is too thin (less than 5 mm). 	<ul style="list-style-type: none"> a) Adjust scoring pressure, see section III. A. b) Do not touch clamping head or scoring shaft while locking. c) Use thicker glass or reduce scoring pressure, see section III. A.
5. No fracture is obtained even when breaking knob is turned fully clockwise.	<ul style="list-style-type: none"> a) Too faint score. b) Dull or damaged cutter wheel. c) Improper glass quality. d) Improper locking of clamping head (8). e) Strip touched by hand while locking. f) Foreign matter underneath support plate (16) and/or glass strip. g) Glass strip is too narrow. 	<ul style="list-style-type: none"> a) Increase scoring pressure, see section III. A. b) Replace cutter wheel, see section III. B. c) Use recommended glass quality. d) Release locking lever (2) and reclamp. e) Let strip adjust itself freely while locking f) Remove glass splinters or other litter from top surface of apparatus. g) Use strip having proper width.
6. Improper clamping of glass due to locking lever (2) touching cover plate.	<ul style="list-style-type: none"> a) Normal wear or set screw (6) loosened. 	<ul style="list-style-type: none"> a) Loosen set screw (6) behind cover screw (7). Hold lever (2) <i>horizontally</i> with black ball directed towards operator. Turn sleeve (4) backwards to stop. Tighten set screw <i>securely</i>. Replace screw (7).
7. Scoring line too long though proper setting of (22) and (13) have been used.	<ul style="list-style-type: none"> a) Cutter wheel diameter too large. b) Scoring mechanism defective. 	<ul style="list-style-type: none"> a) Use proper type of wheel. b) Adjustment needed (must be performed by service engineer).

V. SPARE PARTS and SUPPLIES

Glass Strips, LKB 7890-04 (400×25) thickness 6—7 mm (pkt of 30) or 7890-05 (400×38) thickness 6—7 mm (pkt of 20).

Cutter Wheels and mounting shaft, LKB 7894-01 (set of three).

Tool Kit, LKB 7896-01, including one 2½ mm Allen wrench and one 6 mm wrench.

Fork for handling glass pieces, LKB 7802 A.

Angle setting plate, LKB 7890-03.

Damping pad, LKB 7894-02 (pkt of 5).