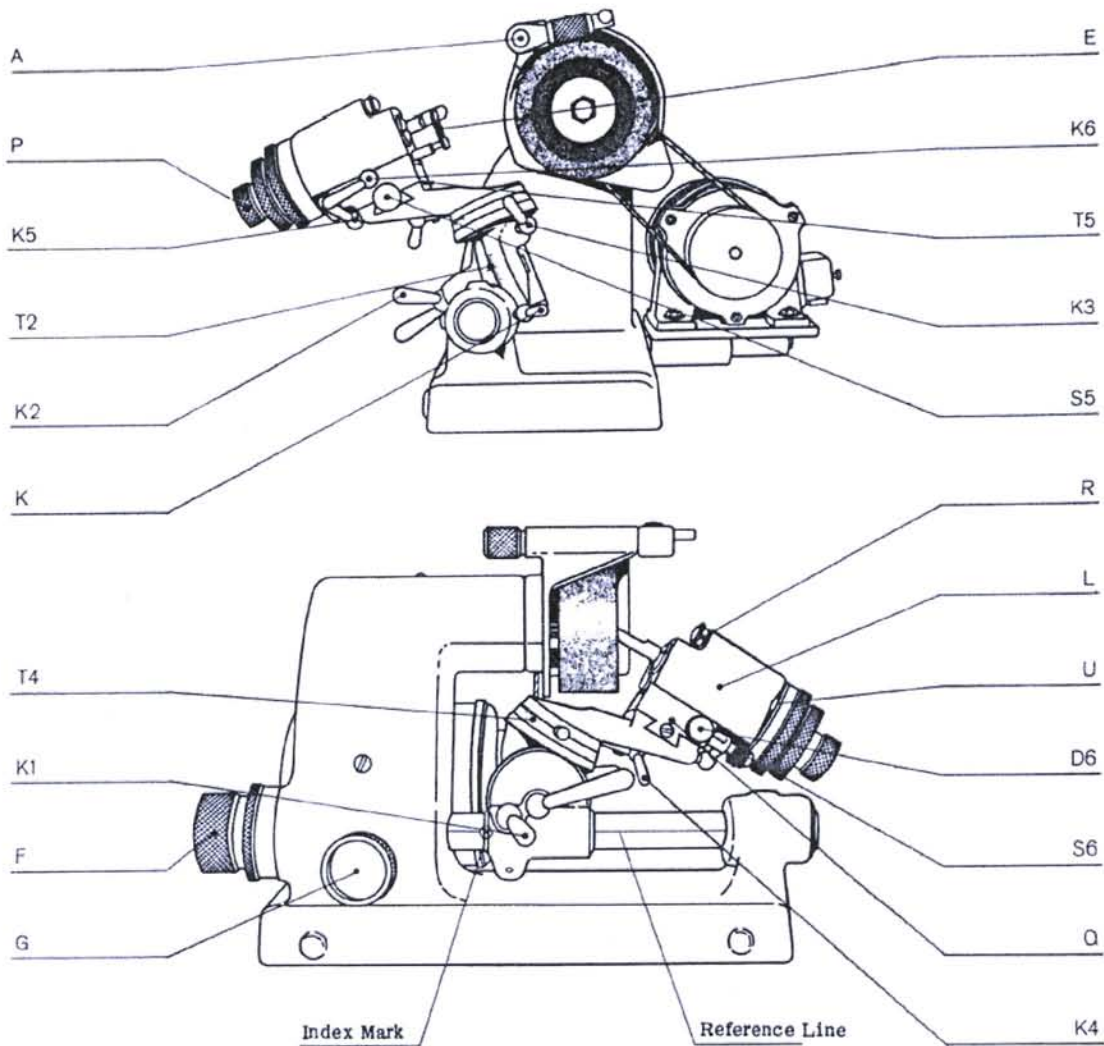


# Names and Explanation of Controls

SO



- |  |   |
|--|---|
| A Wheel Dressing Attachment                | K6 Longitudinal Slide Clamping Lever              |
| D6 Index Head Slide Fine Adjustment Screw  | L Longitudinal Slide                              |
| E Cutter Lip Aligning Gauge                | P Spring Collet Clamping Quill                    |
| F Index Head Bracket Fine Adjustment Screw | Q Cross Slide                                     |
| G Adjustable Stop Screw                    | R Spring Collet Index Pin                         |
| K Tubular Rail Clamping Lever              | S5 Cross Slide Adjustment Screw                   |
| K1 Vertical Swivel Mount Clamping Lever    | S6 Longitudinal Slide Micrometer Screw            |
| K2 Index Drum T2 Clamping Lever            | T2 Vertical Swivel Mount Setting Scale            |
| K3 Horizontal Swivel Mount Clamping Lever  | T4 Horizontal Swivel Mount Index Drum             |
| K4 Index Drum T4 Clamping Lever            | T5 Cross Slide Vernier Scale for Off-Center Radii |
| K5 Cross Slide Clamping Lever              | U Red Dot Window                                  |

- 1 Names and Explanation of Controls
- 2 Installation of Machine Lamp  
Plan Dimensions
- 3 Lubrication - Spindle Adjustment  
Changing Drive Cords and Grinding Wheels
- 4 Servicing the Index Head Bracket
- 5 Wheel Dressing Instructions
- 6 Cutter Profiles - Tool Angles - Cutting Speeds
- 7 Centering the Cutter Lip by Grinding
- 8 Circular Grinding of Cutters  
Grinding the Back Rake Angle of Side Cutting Edges
- 9 Circular Grinding of Cutters  
Grinding the Back Rake Angle of End Cutting Edges (Straight)
- 10 Circular Grinding of Cutters  
Grinding the Back Rake Angle of End Cutting Edges (Round)
- 11 Grinding Pointed Cutters
- 12 Grinding Tapered Cutters  
A - Circular Grinding of Side and End Cutting Edges
- 13 Grinding Tapered Cutters  
B - Grinding the Back Rake Angle of Side and End Cutting Edges (Straight)
- 14 Grinding Tapered Cutters  
C - Grinding the Back Rake Angle of Side and End Cutting Edges (Round)

This Instruction Book is Intended for Machine Nr. . . . . .

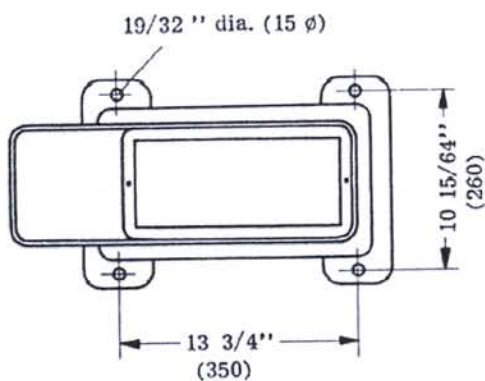
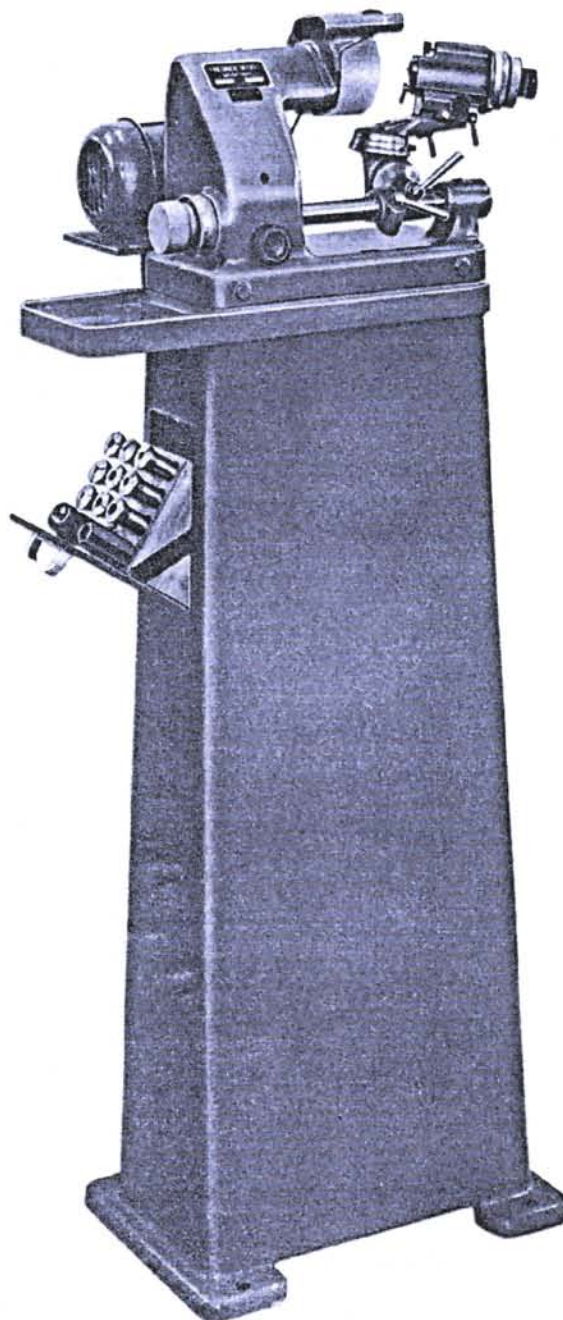
MODEL SO SINGLE LIP CUTTER GRINDER  
WITH FLOOR MOUNTED STAND

JS-2318

A rugged box-type stand is now available  
for the Model SO single-lip cutter grinder.

This vibration-proof stand of all-steel welded construction makes it possible conveniently to install the single-lip cutter grinder independently of a work bench or a wall bracket and to place its controls at the most suitable level for maximum ease of operation.

The stand incorporates a handy tool  
tray and a swing-out fitted accessory box.



Items in parenthesis are given in mm.

Overall height of stand 38 1/2" (980)  
Dimensions of stand base 17 3/4" x 11 7/8"  
(450 x 300)  
Weight 77 lbs. (35 kgs.)

Friedrich Deckel München

# General Information

on the Operation and Lubrication

## of Deckel Universal Type Machine Tools

1. Selecting the proper grades of lubricants will increase the dependability and economy of Deckel machine tools.
2. Lubricating oils and greases must be handled and stored with extreme care: Keep barrels, drums and other vessels clean and be sure tightly to close the containers whenever a supply of oil or grease has been removed. Oil cans and the like must also be kept perfectly clean.
3. The lubricating points of the machines must also be kept perfectly clean in order to prevent the ingress of dirt; after servicing, be sure to close all closures opened for this purpose.
4. Closely follow lubrication schedules supplied with the machines, making allowance for the amount of work performed.
5. Be always sure accurately to position the oil or grease gun on the respective nipples. Make sure that a sufficient amount of lubricant reaches the point to be serviced.
6. Use only non-linting cleaning rags (no cotton waste) to clean the oil reservoirs and pockets. It is recommended to use cleaning oil to remove any residue such as dirt, sludge, etc. The cleaning fluid must be completely removed.
7. It is advisable always to use the same grade of lubricant and not to change the lubricant without completely removing the old lubricant by a thorough cleaning.
8. In the case of antifriction bearings, approximately  $\frac{1}{8}$  only of the free space should be filled with grease. Bearings running at high speed may be overheated upon an excessive supply of lubricant being introduced.
9. Guide ways should always be kept free of dirt, dust and chips; where wipers are provided, these should be cleaned at regular intervals.

### Recommended Lubricants for Deckel Universal Type Machine Tools

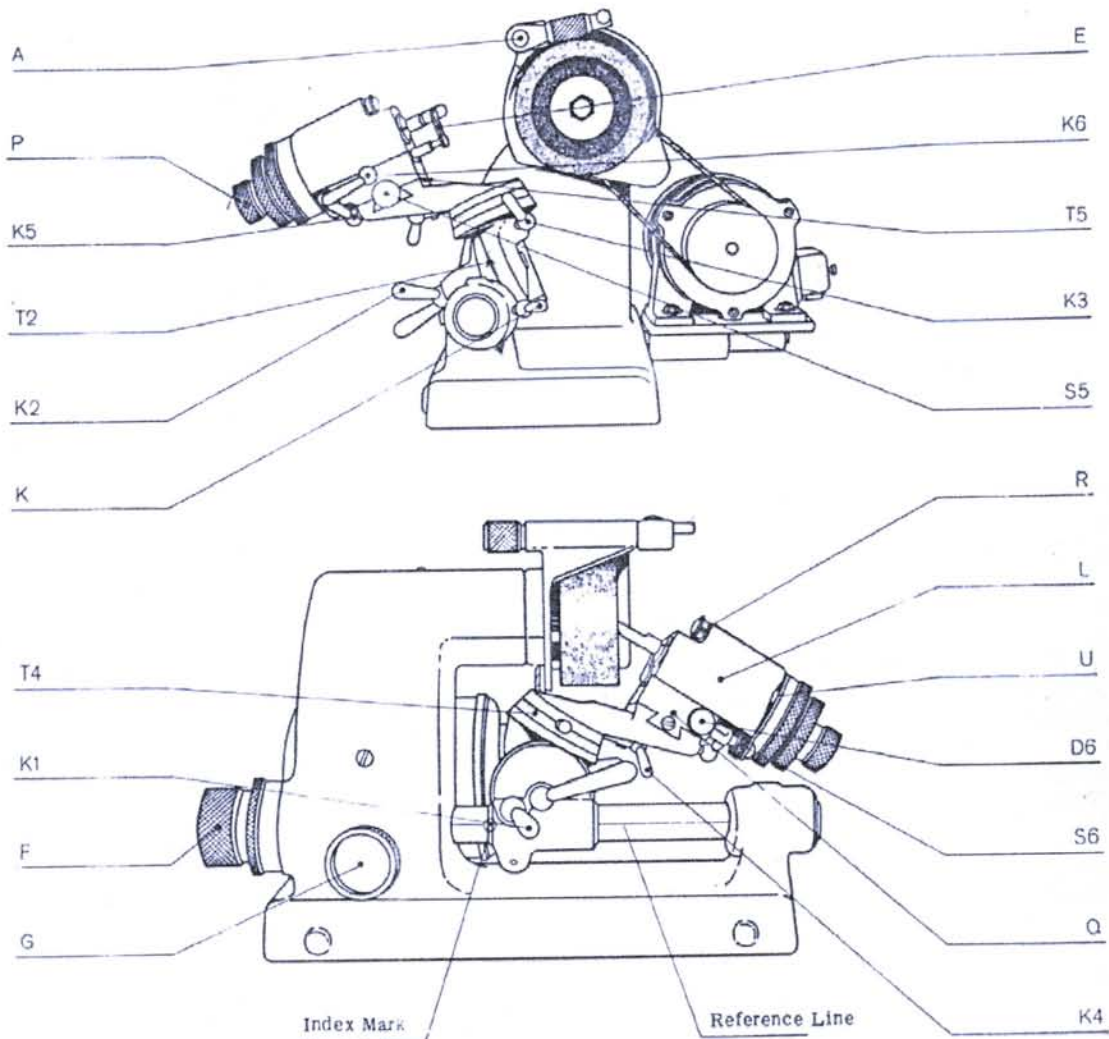
	BP	BV-ARAL	ESSO
Oil 3 E/20° C	ENERGOL H. P. 3	BV-Oil HRT	SPINESSO 34
Oil 4 E/50° C	ENERGOL H. P. 20	BV-Oil HLX	ESSTIC 50
Grease	ENERGREASE L. S. 2	BV-Grease HL 18	ANDOK M-275
	GASOLIN	SHELL	MOBIL
Oil 3 E/20° C	GASOLIN RL Spindle Oil	SHELL Vitrea Oil 13	Mobil Velocite Oil No. 6
Oil 4 E/50° C	GASOLIN K Special Oil	SHELL Vitrea Oil 31	Mobil Vactra Oil Heavy Medium
Grease	DEGANOL I Special Grease	SHELL Alvania Grease 2	Mobilgrease BRB No. 1

The lubricants listed above are available to uniform quality standards from the firms listed on the reverse side of this sheet.  
The order in which the suppliers of the lubricants are named does not constitute an order of rank or quality.

Friedrich Deckel · Munich

# Names and Explanation of Controls

SO



- |  |   |
|--|---|
| A Wheel Dressing Attachment                | K6 Longitudinal Slide Clamping Lever              |
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| K Tubular Rail Clamping Lever              | S5 Cross Slide Adjustment Screw                   |
| K1 Vertical Swivel Mount Clamping Lever    | S6 Longitudinal Slide Micrometer Screw            |
| K2 Index Drum T2 Clamping Lever            | T2 Vertical Swivel Mount Setting Scale            |
| K3 Horizontal Swivel Mount Clamping Lever  | T4 Horizontal Swivel Mount Index Drum             |
| K4 Index Drum T4 Clamping Lever            | T5 Cross Slide Vernier Scale for Off-Center Radii |
| K5 Cross Slide Clamping Lever              | U Red Dot Window                                  |

Note: For easy reference fold out second copy of this sheet provided at the end of this instruction book.

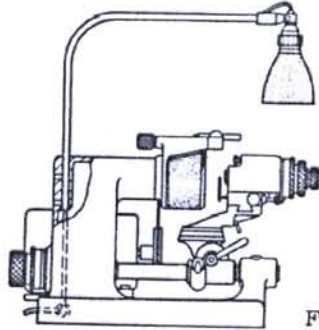


Fig. 1

**Connecting Machine to Power Line**

After placing the machine on a suitable workbench, connect the cable to the motor terminals.

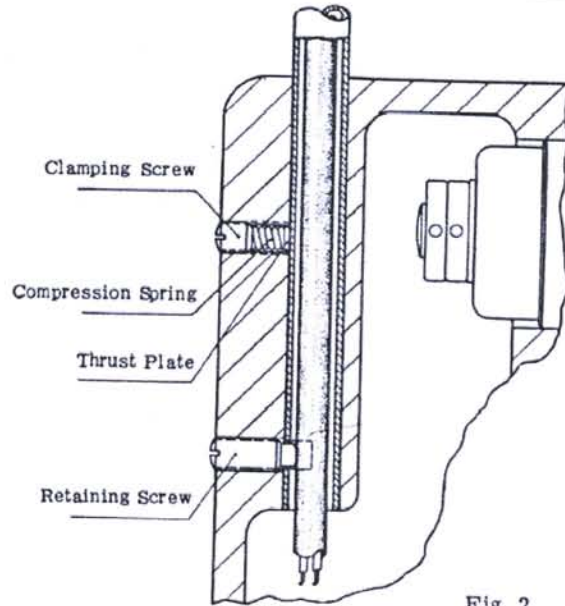
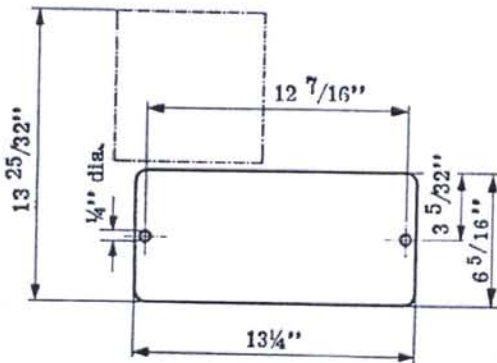
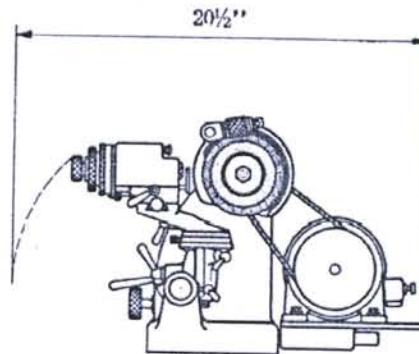
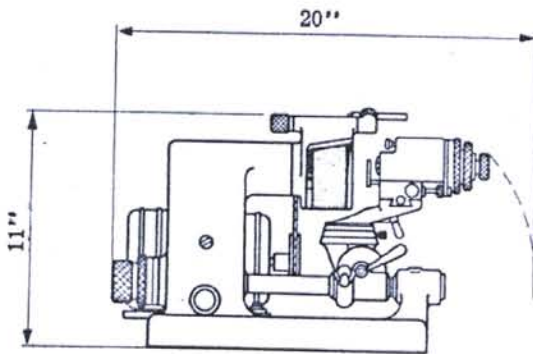


Fig. 2

**Installation of Machine Lamp**

The Model SOZL lamp furnished with the machine is wired ready for use. Slide lamp tube into vertical bore provided in upper portion of spindle head. Push tube down until retaining screw registers with tube slot. Insert thrust plate and compression spring and tighten clamping screw (see Fig. 2). Thread cable through hole in machine base and connect to lighting circuit (see Fig. 1).



**Chucking and Grinding Capacity**

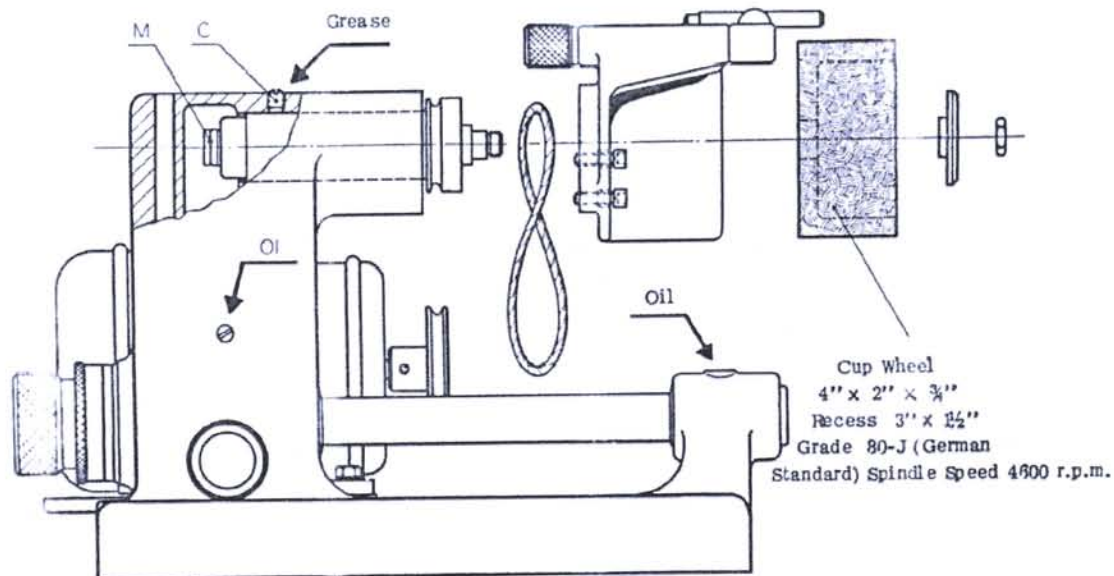
Max. Dia. of Hole in Collet 15/32"  
 Max. Radius Ground 25/64"  
 (Radius ground will increase in proportion to wheel wear.)

**Wheel Spindle Drive**

Horsepower of Motor H.P. 0.25  
 Speed of Motor R.P.M. 2800  
 Speed of Wheel Spindle R.P.M. 4500

**Dimensions and Weight**

Length	Width	Height	20"	20 1/2"	11"
Net Weight	55 lbs.				



#### Lubrication of Machine

At weekly intervals, remove oil hole plugs marked in red and administer a few drops of high-grade machine oil (viscosity 4.3 to 6.5 at 122° F.). Be sure to oil all guide ways from time to time. During grinding operations, however, keep guide ways free of oil and grease to avoid adhesion of abrasive dust.

#### Lubrication of Spindle Assembly

At intervals of approximately 100 hours of operation lubricate the spindle with uncontaminated heavy grease. To this end remove plug C and refill the interior of the bearing by means of the grease gun supplied with the machine. Be sure before refilling to clean out the plug hole carefully and to use absolutely uncontaminated grease in order to prevent foreign matter from damaging the ball bearing. It is recommended to dismantle the bearing at intervals of 1000 hours of operation, to wash the parts in gasoline (petrol), and to refill grease.

#### Spindle Adjustment

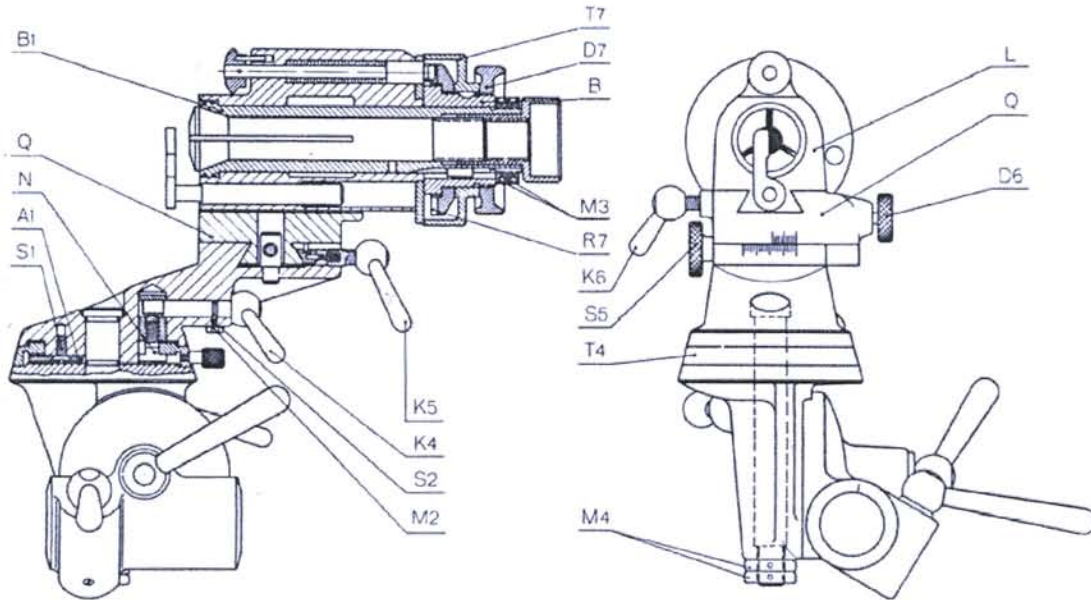
The spindle bearing is adjusted at the factory for smooth and play-free operation. If excessive play should develop after a major period of operation, the bearing will have to be readjusted by tightening the two nuts M. -Remove wheel, wheel guard, and drive cord (see illustration above). Remove plug C and pull spindle from its seat. When tightening the nuts allow for a free-running spindle. Excessive tightening would result in bearing failure. After reinserting the spindle assembly, carefully tighten plug C to hold the spindle assembly in position.

#### Changing the Drive Cord

To change the drive cord it is necessary to remove the wheel and the wheel guard.

#### Changing the Grinding Wheel

To remove the wheel, remove the retaining nut and the washer. By virtue of a slight allowance on the wheel hole diameter it is possible to set the wheel for true running. Excessive out-of-round will have to be taken care of by truing the wheel by means of a diamond or carborundum dresser. Vibration-free operation will greatly extend the service life of the machine.



#### General

After a major period of use it will be necessary to dismantle the index head bracket and to clean and lubricate the moving parts. Particular attention should be given the collet sleeve bearing, the index head slide, and the swivel arm.

#### Collet Sleeve Bearing

To remove the collet sleeve proceed as follows: Remove ring nut D7, index drum T7, and index ring R7 in that order. Remove two nuts M3. Pull out index ring bearing sleeve B and collet sleeve B1. The annular grease chamber in the longitudinal slide L which has thus been made accessible will then have to be cleaned with gasoline (petrol) and refilled with heavy grease.

#### Index Head Slide

Release clamping screw K6 and remove screw D6. Pull out longitudinal slide L. Clean all working surfaces, smear lightly with oil, wipe dry. -Cross slide Q cannot be removed. Release clamping screw K5 and turn screw S5 to move the cross slide to its extreme positions. Clean the bearing surfaces, smear lightly with oil, wipe dry.

#### Swivel Arm

To remove the swivel arm and the index head as a unit remove the two nuts M4. Clean the bearing surfaces and smear them with oil.

#### Adjusting the Clamping Mechanism of the Swivel Arm Index Drum

If after a major period of use clamping lever K4 should no longer lock swivel arm index drum T4, screw N will have to be adjusted. For this purpose proceed as follows: Remove swivel arm as described above; remove screw S1 and plate A1; back off nut M2 and screw S2 and pull out clamping lever K4. Lift off index drum T4 to pull out adjusting nut and screw N. Rotate screw 180° relative to nut to reduce the length. -To reassemble parts reverse this procedure.

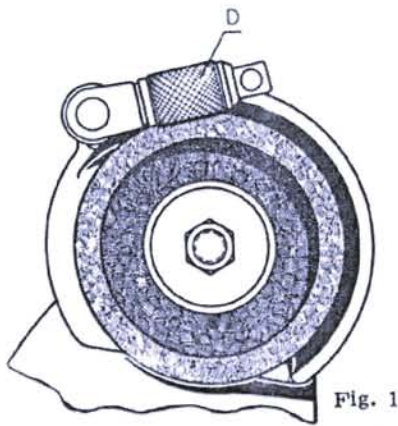


Fig. 1

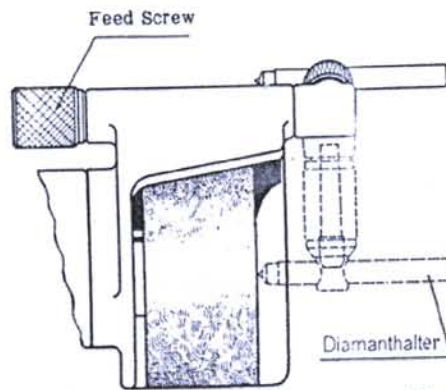


Fig. 2

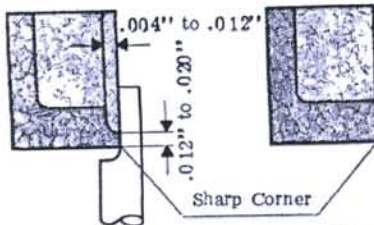


Fig. 4

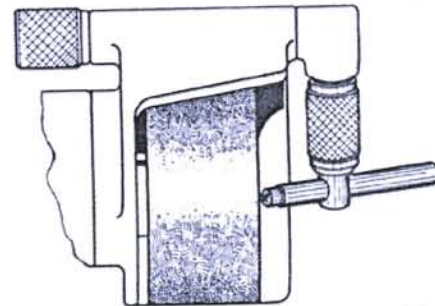


Fig. 3

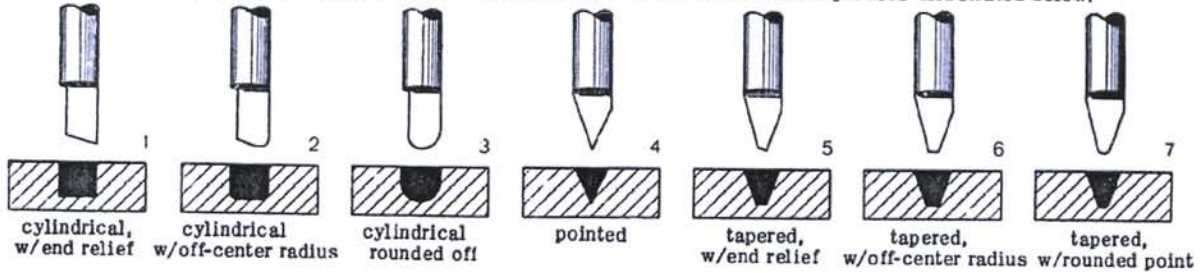
Wheel truing and dressing should be performed at regular intervals. Dressing is done by means of a diamond set in a tip which is held in a swiveling rod. The latter is attached to a swinging arm which is provided with a feed screw. The diamond tool assembly is supported by the wheel guard (see Figs. 1 and 2). Wheel truing and dressing is particularly necessary when the wheel has become loaded or when the sharp corner has been worn off. Failure to comply with this rule will result in poor surface finish and overheating of the cutting tools.

Always be sure to use a sharp-pointed diamond having the proper clearance angle. The wide range of diamond adjustment ensures economical utilization of diamonds. As will be seen from Fig. 3, the diamond can be set at any desired position relative to the grinding wheel, since it can be rotated about its axis and set for endwise position. To reset the diamond back off nut D to release the tapered shank of the diamond holder. After resetting be sure to tighten nut D. Care should be exercised not to allow the wheel to attack the tip in which the diamond is set. When centering the lip surface of a single-lip cutter it is necessary to relieve the wheel face except for a narrow rim portion (see Fig. 4). This will exclude overheating of the tool being ground.

Prior to finish grinding the cutter be sure to remove the rim portion.

**Cutter Profiles**

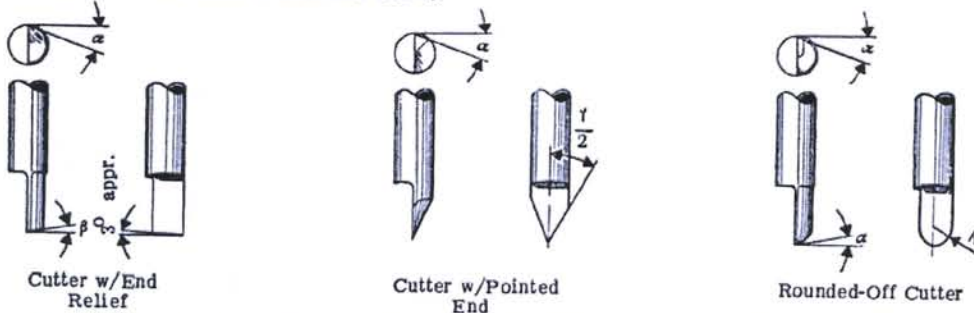
As a rule, single-lip milling cutters are given one of the seven basic profiles illustrated below:



Above are illustrated the seven basic cutter profiles and cross-sectional views of the profiles they will produce.

**Tool Angles**

As is the case with all metal cutting tools, single-lip milling cutters require the proper amount of cutting edge relief or back rake angle for maximum stock removal and high surface finish. As regards single-lip cutters, three different tool angles will have to be taken care of, these angles being used in all kinds of cutters (see illustrations below).



Angle  $\beta$  applies for end relieved cutters only. Cutters having an angle  $\alpha$  of less than  $20^\circ$  should be relief ground at between  $25^\circ$  and  $30^\circ$  (see special instructions).

Tool Angles and Recommended Cutting Speeds for Single-Lip Cutters

Material to be cut	Tool Angles			Recommended Cutting Speeds for High Speed Steel Single Lip Cutters, sfm	
	$\alpha$	$\beta$	$\gamma$	Roughing Cut	Finishing Cut
Grey cast iron	25°	15°	5°	195	260
Cast steel					
Malleable cast iron					
Machinery steel 47,000 to 85,000 psi	25°	15°	5°	230	295
85,000 to 115,000 psi				195	230
over 115,000 psi				130	165
Tool steel soft grade				195	260
Tool steel hard grade	30°	15°	5°	165	230
Brass Ms 58 soft grade				655	820
Brass Ms 58 hard grade				820	1150
Brass Ms 63 soft grade	30°	15°	5°	395	490
Brass Ms 63 hard grade				490	590
Bronze soft grade	35°	15°	5°	525	655
Bronze hard grade				655	755
Aluminium soft grade	35°	15°	5°	655	985
Aluminium hard grade				820	1150
Wood	25°	15°	5°	985	1150
Plastics: Trolon				820	985
Pertinax, Fiber				655	820
Pollopas, Resopal	45°	25°	20°	655	985
Astralon, Celluloid, Plexi				655	1150

**Cutting Speeds**

As regards single-lip milling cutters, it is recommended to use cutting speeds three times higher than those used with standard type milling cutters. The data which are tabulated beside should be used as a guide only, as such factors as drive conditions and available spindle speeds will also have to be taken into consideration. In end cutting edges the cutting speed will decrease towards the cutter center line. This effect is particularly noticeable in rounded-off cutters. As a consequence care should be taken that stock is preferably removed by the outer portion of the cutting edge. For example, where inclined surfaces are concerned, stock should preferably be removed by milling in an upward direction rather than downward.

When cutting soft aluminium, petroleum (kerosene) has to be used as a coolant. When cutting celluloid, the cutter must always be in feed motion, in order to avoid inflammation.

Cylindrical single-lip milling cutters are supplied by the manufacturer with the lip preformed by rough milling (see Fig.1). As a result, the cutter lip will first have to be accurately centered by grinding. Rough grinding of the lip is performed manually by holding the cutter against the circumference of the grinding wheel (see Fig.2). This operation is followed by finish grinding in the machine. The off-center tolerance is  $\pm .0004''$  which should be checked with a micrometer caliper (see Fig.3). To grind the cutter lip correctly, proceed as follows:

### Setting-Up

1. Set swivel arm and index drum T4 at zero, tighten clamping lever K3; set vertical setting scale T2 at zero, tighten clamping lever K2. (see Fig.4).
2. Bring red dot into window U, have index pin R engage the central hole (see Fig.5).
3. Set cutter with aligning gauge E, clamp cutter in position, return aligning gauge E. (see Fig.6)
4. Withdraw index pin R, rotate spring collet bearing 180°, allow index pin R to engage the central hole.
5. Tighten clamping lever K, release clamping lever K1. Shift index head bracket along tubular rail to bring cutter lip into light contact with end face of grinding wheel. Be sure, prior to tightening clamping lever K1, to align vertical swivel mount index mark with reference line on tubular rail. Tighten clamping lever K1, release clamping lever K.

### Centering the Cutter Lip

6. Fine adjustment screw F serves to set the index head accurately relative to the wheel and to provide the desired depth of cut. The travel of the cutter past the wheel can be limited by means of adjustable stop screw G. Thus it is possible, during grinding to advance the cutter as far as it will go. To bring the cutter lip within the prescribed off-center tolerance, reciprocate the index head bracket while advancing the cutter by rotating fine adjustment screw F.

In order to prevent the cutter from being overheated, it is recommended to leave only a narrow cutting zone on the grinding wheel (see Page 5 "Wheel Dressing Instructions"). The length of the cutter lip should equal one and one-half times the diameter of the cutter.

It is not advisable to increase the length of the cutter lip beyond a certain limit. In the case of deep engraving work where stepped cutters are used the shank of the cutter will be increased instead of the lip.

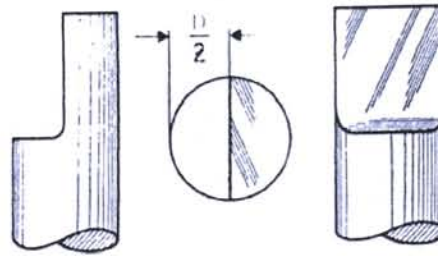


Fig. 1



Fig. 2

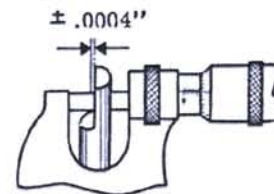


Abb. 3

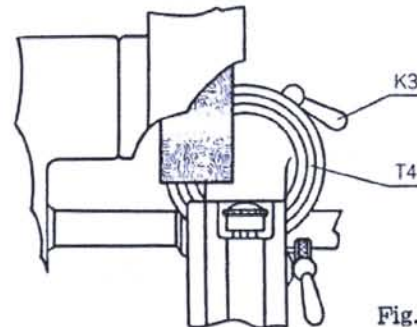


Fig. 4

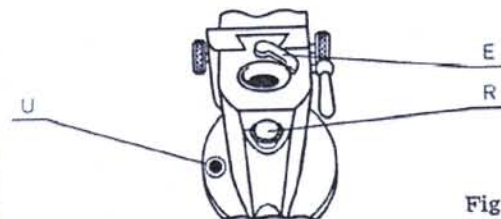


Fig. 5

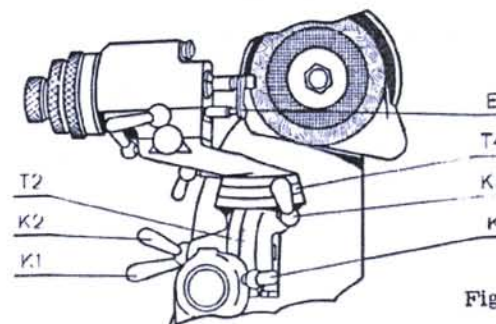


Fig. 6

## Circular Grinding of Cutters - Grinding the Back Rake Angle of Side Cutting Edges

After centering the cutter lip it will be necessary to grind the back rake angles of both the side cutting edge and the end cutting edge. The back rake angles of both cutting edges should be selected to suit the material to be cut (see Page 6).

To grind the back rake angle of the side cutting edge of cylindrical cutters (Fig. 1) proceed as follows:

### Setup Operations

1. Rotate swivel arm to set index drum T4 at zero; tighten clamping lever K3.
2. Bring red dot into window U; engage index pin R into central hole.
3. Align cutter by means of gauge E; grip cutter in position; return gauge E, see Fig. 2.
4. Release clamping lever K2; set swivel arm at desired back rake angle, using setting scale T2; tighten clamping lever K2; see Fig. 3.
5. Tighten clamping lever K; release clamping lever K1; shift work fixture on tubular rail to bring cutter into light contact with grinding wheel.

Align index mark of vertical swivel mount with reference line on tubular rail; tighten clamping lever K1; release clamping lever K.

### Circular Grinding

6. Engage index pin R into right-hand hole; grind desired diameter by rotating spring collet bearing through  $360^\circ$ . During this operation slowly rotate adjustable stop screw G, while continuously rotating the spring collet bearing, to advance the work fixture past the grinding wheel; this will produce uniform stock removal. Fine adjustment during circular grinding is by screw F. Stop screw G is used to establish the length of the cylindrical portion which should always be slightly longer than the cutting lip.

### Setup Operations

7. Return red dot into window U; engage index pin R into left-hand hole to enable the collet bearing to be rotated  $180^\circ$  between the index plate stops.

### Grinding the Back Rake Angle

8. When grinding the back rake angle, use the fine adjustment screw F over the entire range of rotation of the collet bearing (see Fig. 3a). Production of the back rake angle is positively controlled. The angle is required to extend over the entire length of the cutting lip.

The vertical swivel bearing, which permits the work holding fixture to be swung back, enables relief angles up to  $40^\circ$  to be produced. Relief angles over  $40^\circ$  can be obtained by additionally rotating the collet bearing in the index head. (Only for cylindrical or conical cutters with straight end cutting edges or for pointed cutters.)

Upon completion of grinding operations a very narrow land must remain at the cutting edge (see Fig. 4)

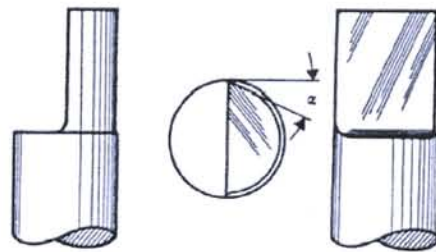


Fig. 1

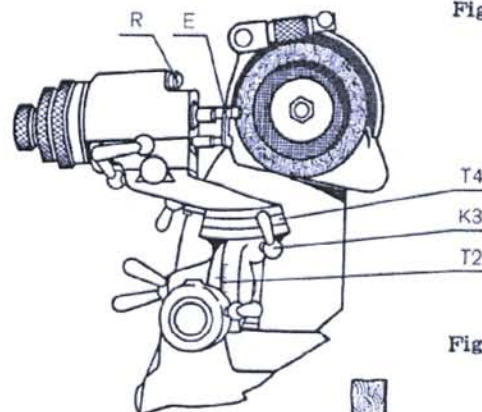


Fig. 2

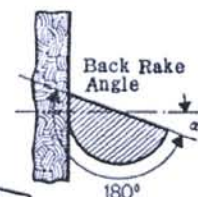
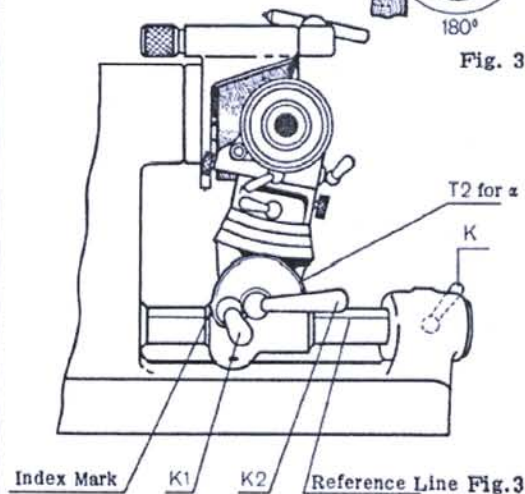


Fig. 3a



Index Mark K1 K2 Reference Line Fig. 3

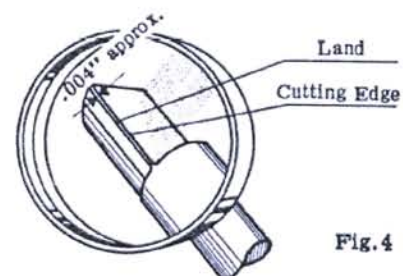


Fig. 4

# Circular Grinding of Cutters - Grinding the Back Rake Angle of End Cutting Edges (Straight)

SO

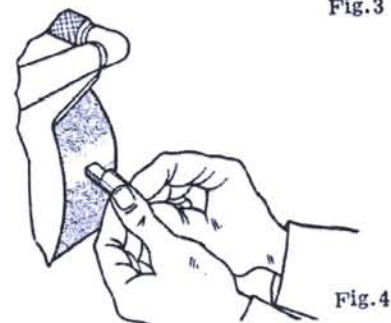
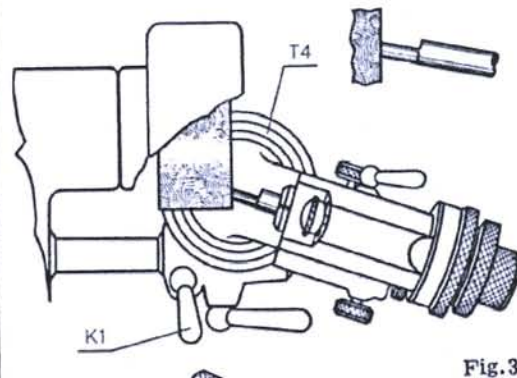
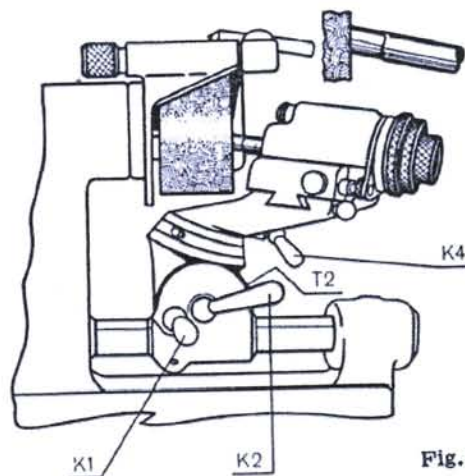
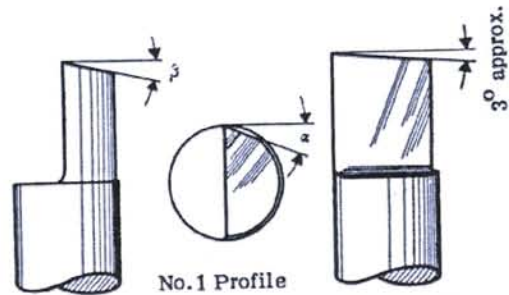
The end cutting edge illustrated in Fig.1 may be ground in an operation immediately following the grinding of the side cutting edge; or it may be ground independently. In the latter case the cutter will have to be aligned by means of gauge E and clamped in position. Whenever a single-lip cutter is to be ground, the aligning gauge will have to be used, as one leg of the cutting angle is formed by the cutting lip surface. The back rake angle should be selected to suit the material to be cut (see Sheet 2109).

### 1 Setup Operations

1. Engage index pin R into central hole; bring red dot into window U.
2. Release clamping lever K2; using setting scale T2, set swivel arm at  $3^{\circ}$  approx.; tighten clamping lever K2.
3. Release clamping levers K3 and K4; hold index drum T4 against stop and, beginning at  $90^{\circ}$ -position, set swivel arm at desired angle; for example set arm at  $75^{\circ}$  for back rake angle of  $15^{\circ}$ . (See Fig.2 and 3). Tighten clamping levers K3 and K4.
4. Tighten clamping lever K; release lever K1; shift work fixture on tubular rail to bring cutter into light contact with grinding wheel. Align index mark of vertical swivel mount with reference line on tubular rail; tighten clamping lever K1; release lever K.

### Grinding the Back Rake Angle

5. Fine adjustment screw F serves to set the index head laterally relative to the wheel and to set the work for the desired depth of cut. - It is also possible to produce the desired back rake by holding the cutter against the circumference of the grinding wheel as is shown in Fig.4.



## Circular Grinding of Cutters – Grinding the Back Rake Angle of End Cutting Edges (Round)

Cutter profiles having either on-center or off-center radii are derived from cylindrical single-lip cutters having a straight end cutting edge by rounding off the corner as shown in Figs. 2 and 3 (Nos. 2 and 3 Profiles).

In rounded cutters of this type the back rake angle of the side cutting edge is the same as that of the end cutting edge. For this reason it is necessary, during grinding the end rake angle, that the work fixture is set at the side rake angle by means of setting scale T2. If the end cutting edge is ground immediately after grinding the side cutting edge, it will not be necessary to re-set the work fixture and to re-align the cutting lip by means of gauge E.

### Setup Operations

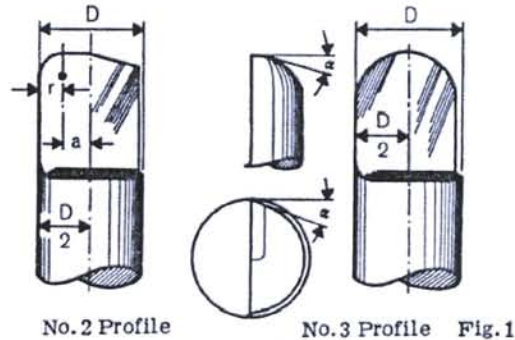
1. Engage index pin R into left-hand hole; bring red dot into window U.
2. No.2 Profile: Release Clamping Lever K5; rotate knurled knob S5 to set cross slide by means of vernier scale T5 for desired radius (to the right); tighten clamping lever K5, see Fig.2. As the radiused corner is required to be tangent to the cutter diameter, the amount of off-set  $a$  is  $D/2 - r$ .  
Example: Given  $r = .06''$ ;  $D = .30''$   
 $a = .15'' - .06'' = .09''$
- 2a. No.3 Profile: The vernier scale T5 of the cross slide must be set at zero (see Fig.3).
3. Rotate fine adjustment screw F to bring the side cutting edge of the cutter into light contact with the face of the grinding wheel. Caution: Do not injure the land of the side cutting edge. Now screw F must no longer be rotated.

### Grinding the Back Rake Angle

4. Swivel index head through  $90^\circ$  (see Fig. 4); Depth of cut adjustment now is by longitudinal slide L. Fine adjustment is by micrometer screw S6 of the longitudinal slide with adjustment screw D6 tightened. The end of the cutter is rounded by slowly swiveling the index head back to its original position, while the collet bearing is continuously rotated back and forth between the stops, the rotation being through  $180^\circ$ . (See Figs. 5 and 6). Prior to grinding, be sure to withdraw the index head a slight amount by rotating screw S6 in order to prevent overheating of the cutter by excessive stock removal. After each pass of the grinding wheel the cutter is then fed towards the wheel by means of screw S6.

In order to obtain a satisfactory cutting edge it is advisable, as a final operation, to swivel the index head through  $90^\circ$  with the cutter lip pointing vertically upward.

In cases where cutters given a No.3 profile are intended for the machining of hard steel which requires a small back rake angle, it is good practice to flatten the curvature of the cutter by a manual grinding operation as shown in Fig.7.



No. 2 Profile

No. 3 Profile Fig. 1

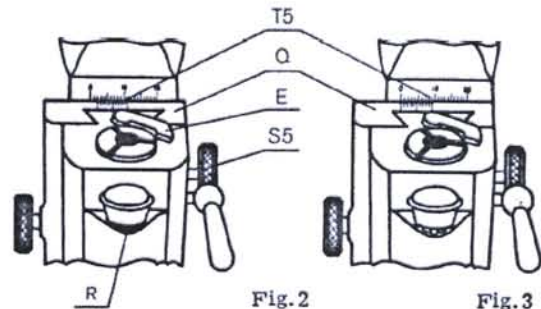


Fig. 2

Fig. 3

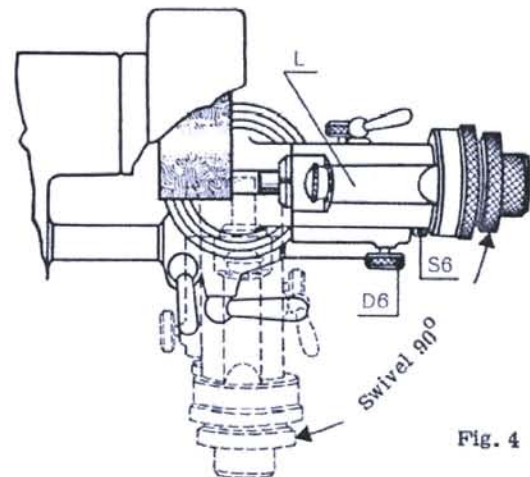


Fig. 4

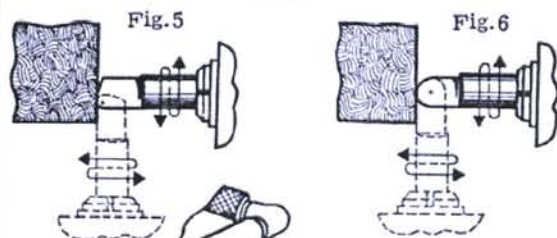


Fig. 5

Fig. 6

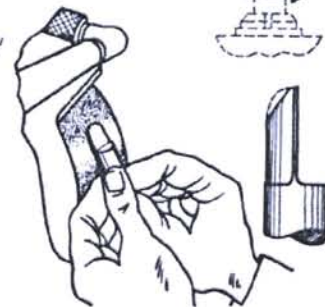


Fig. 7

Where pointed cutters are concerned, both the included angle of the point and the back rake angle are produced in one operation (see Fig. 1). The back rake angle should be selected to suit the material to be cut (see Sheet 2109).

### Setup Operations

1. Engage index pin R into central hole; bring red dot into window U.
2. Align cutter lip by means of gauge E; grip cutter in position; return gauge E;
3. Engage index pin R into left-hand hole to enable collet bearing to be rotated 180° between stops.
4. Release clamping levers K3 and K4; hold index drum T4 against stop and, beginning at zero position, set swivel arm at one-half the desired point angle (see Fig. 2).

Example: Given a point angle of 60°. Set swivel arm by index drum T4 at 30°. Retighten clamping levers K3 and K4.

5. Release clamping lever K2; set work fixture for desired back rake angle by means of setting scale T2, see Fig. 3. Tighten clamping lever K2.
6. Tighten clamping lever K; release lever K1; shift work fixture on tubular rail to bring cutter into light contact with grinding wheel. Align index mark of vertical swivel mount with reference line on tubular rail; tighten clamping lever K1; release lever K.

### Grinding the Back Rake Angle

7. During grinding slowly return stop screw G to advance the work fixture past the wheel; at the same time continuously rotate the collet bearing back and forth between the stops, the rotation being through 180°. This ensures uniform stock removal (see Figs. 4a, b, c). Uniform stock removal will protect the cutter from overheating.

Whet the cutter point by means of an oil stone. It is advisable to whet the point as far as engraving conditions permit. This operation will give the point a small end cutting edge which will participate in removing stock (see Fig. 5). However, where hairline engraving work is concerned (depth of cut not exceeding .0004"), the shape of the point should not be changed; only the cutting edge proper should be carefully whetted.

In addition it is recommended to whet also the cutting lip by means of an oil stone in order to remove burrs. However, care should be exercised not to remove noticeable amounts of stock from the cutting lip, as this would destroy the centering of the lip; moreover, this would render a greater or lesser part of it useless. When grinding the cutting lip for the first time, care has to be taken to grind with a positive tolerance.

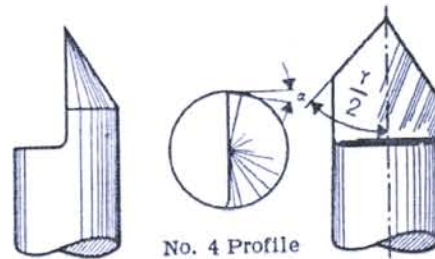


Fig. 1

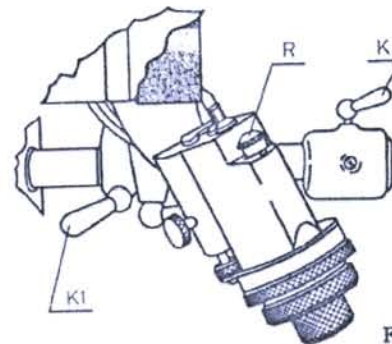


Fig. 2

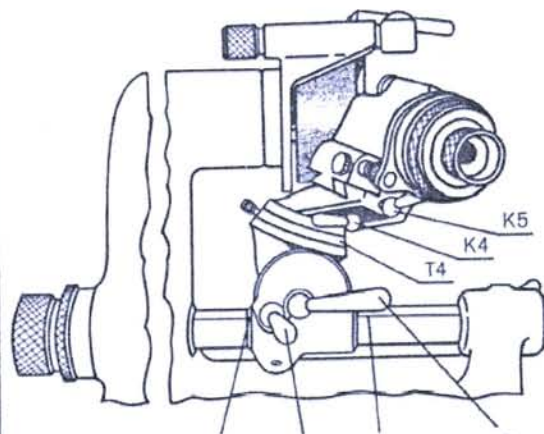


Fig. 3

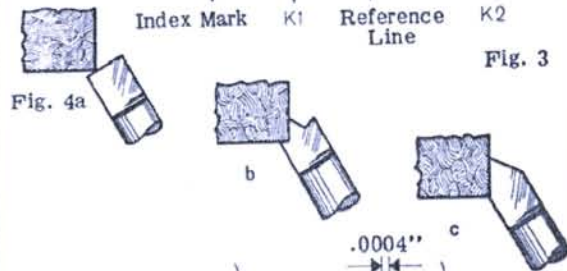


Fig. 4a

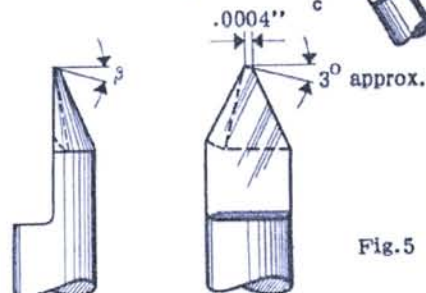


Fig. 5

## Grinding Tapered Cutters -

## (A) Circular Grinding of Side and End Cutting Edges

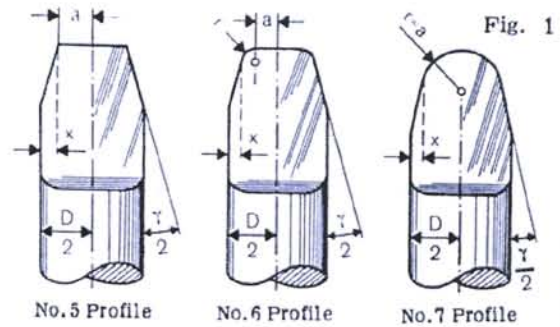
Tapered cutters can be ground to size in the machine without the use of any measuring instrument, except for the scales provided on the machine. For circular grinding operations on profiled cutters follow this procedure;

**Setup Operations**

1. Engage index pin R into central hole; bring red dot into window U.
2. Align cutter lip by means of gauge E; grip cutter in position; return gauge E.
3. Engage index pin R into right-hand hole to enable collet bearing to be rotated through 360°. Release clamping levers K2, K3, K4. Set scales T2 and T4 at zero. Tighten clamping levers K, K2, K3, K4, see Fig.4.
4. Release clamping lever K1; bring cutter diameter into light contact with grinding wheel; tighten clamping lever K1, taking care to keep index mark of vertical swivel mount aligned with reference line on tubular rail; release clamping lever K, see Fig.4.
5. No. 5 profile (Figs. 1 and 2): Release clamping lever K5; rotate knurled knob S5 to shift cross slide to the right by one-half of the diameter of the taper (a in Fig. 1); for this purpose use cross slide vernier scale T5. Tighten clamping lever K5.
- 5a. No.6 profile (Figs. 1 and 2): Release clamping lever K5; rotate knurled knob S5 to shift cross slide to the right by the desired amount "a" (use cross slide vernier scale T5. Tighten clamping lever K5.
- 5b. No.7 profile (Figs. 1 and 3): Set cross slide vernier scale at zero.
6. Nos.5 and 7 profiles: Rotate fine adjustment screw F to bring cutter diameter into light contact with grinding wheel; Again rotate screw F to shift cutter to the left by amount  $x = \frac{D}{2} - a$ . To facilitate this setting operation, set scale drum of screw F at zero without disturbing the setting of the screw (see Fig.4).
- 6a. No.6 profile: Rotate screw F to bring cutter diameter into light contact with grinding wheel; again rotate screw F to shift cutter to the left by the amount  $x = \frac{D}{2} - (a + r)$ . To facilitate this setting operation, set scale drum of screw F at zero without disturbing the setting of the screw (see Fig. 4).
7. Release clamping lever K3; rotate swivel arm through 90°; release clamping lever K6; rotate longitudinal slide micrometer screw S6 to advance end face of cutter towards grinding wheel. Where tapered cutters are to be resharpened, the length of the cutting edge at the end of the cutter should be made greater than the small diameter of the tapered portion.
8. Release clamping lever K4; hold index drum T4 against its stop and, counting from the zero position, set swivel arm at the desired taper angle; tighten clamping levers K3 and K4, see Fig. 5.

**Circular Grinding**

9. No.5 profile: Slowly return stop screw G and continuously rotate the collet bearing through 360° to advance the cutter past the grinding wheel. Prior to the circular grinding operation rotate fine adjustment screw F to shift the cutter to the right; then advance the cutter towards the wheel by small increments until the desired size has been obtained (see Fig.6).
- 9a. Nos.6 and 7 profiles: Release clamping lever K3; first slowly return stop screw G, then slowly swing the swivel arm while continuously rotating the collet bearing through 360° to move the cutter past the wheel and thus to circular grind both the taper and the radius. Prior to the circular grinding operation rotate fine adjustment screw F to shift the cutter to the right; then advance the cutter towards the wheel by small increments until the desired size has been obtained (see Figs. 7 and 8).



No.5 Profile No.6 Profile No.7 Profile

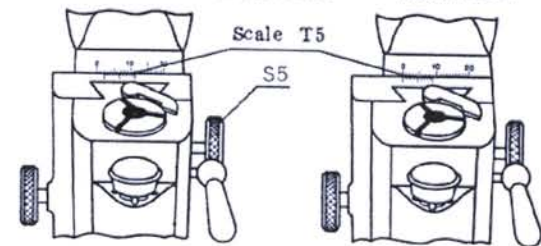


Fig. 2

Fig. 3

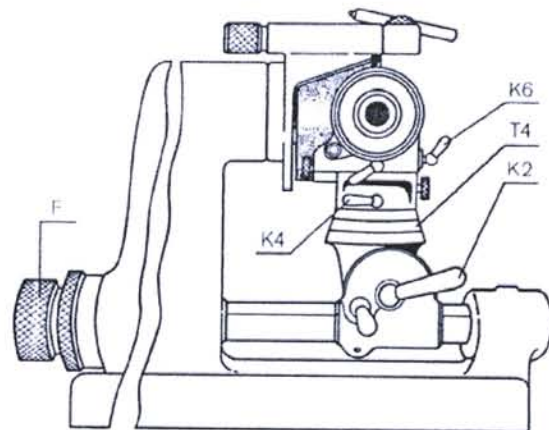


Fig. 4

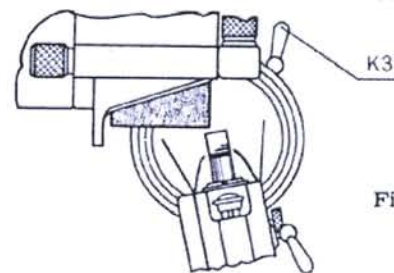


Fig. 5

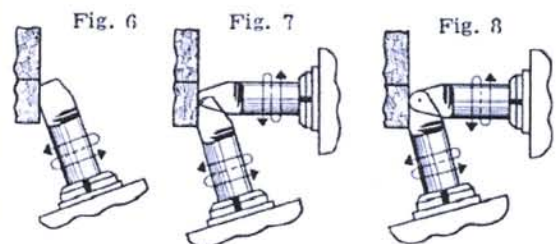


Fig. 6

Fig. 7

Fig. 8

# Grinding Tapered Cutters -

## (B) Grinding the Back Rake Angle of Side and End Cutting Edges (Straight)

SO

The back rake angles of the side and end cutting edges may be ground immediately after circular grinding the desired cutter profile; or in cases where only the taper angle (not, however, the small diameter of the tapered portion) is of importance, grinding may be performed in an independent operation. Where the small taper diameter must be held within close tolerances, only the end cutting face will be ground; in this case the cutter will have to be aligned by means of gauge E and clamped in position. The back rake angles of the side and end cutting edges should be selected to suit the material to be cut ( see Page 6. ). For tool angles refer to Fig. 1.

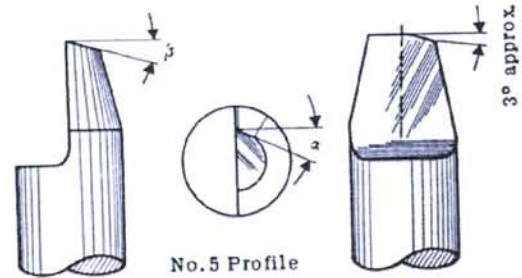


Fig. 1

### Grinding the Side Cutting Edge

#### Setup Operations

1. Engage index pin R into left-hand hole; bring red dot into window U.
2. Release clamping lever K2; using scale T2, set cutter at desired back rake angle; tighten clamping lever K2, see Fig. 2.
3. Tighten clamping lever K; release lever K1; shift work fixture on tubular rail to bring cutter into light contact with grinding wheel; tighten clamping lever K1, taking care to keep index mark of vertical swivel mount aligned with reference line on tubular rail; release clamping lever K.

#### Grinding the Back Rake Angle

4. While continuously rotating the collet bearing through 180° (back and forth between the stops), advance the cutter towards the grinding wheel by means of fine adjustment screw F. This will produce the desired back rake angle in a positively controlled operation (see Fig. 2).

Upon completion of the grinding operations on the side cutting edge, a very narrow land must remain at the edge.

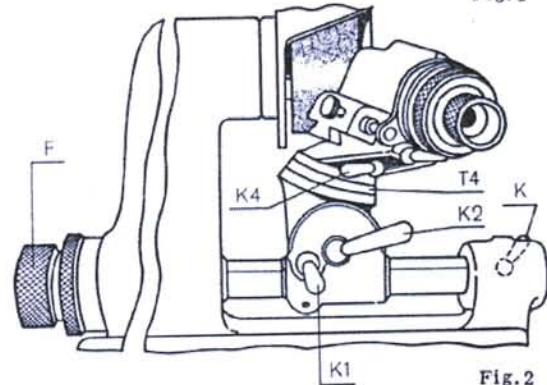


Fig. 2

### Grinding the End Cutting Edge

#### Setup Operations

1. Engage index pin R into central hole; bring red dot into window U.
2. Release clamping lever K2; using scale T2, set swivel arm at an angle of 30° approximately; tighten clamping lever K2, see Fig. 3.
3. Release clamping levers K3 and K4; hold scale T4 against its stop and, beginning at the 90° position, set swivel arm at the desired angle; for example, where an angle of 10° is desired, the swivel arm will have to be set at 80°. Tighten clamping levers K3 and K4, see Fig. 4.
4. Tighten clamping lever K; release lever K1; shift work fixture along tubular rail to bring end face of cutter into light contact with grinding wheel; tighten clamping lever K1, taking care to keep index mark of vertical swivel mount aligned with reference line on tubular rail; release clamping lever K.

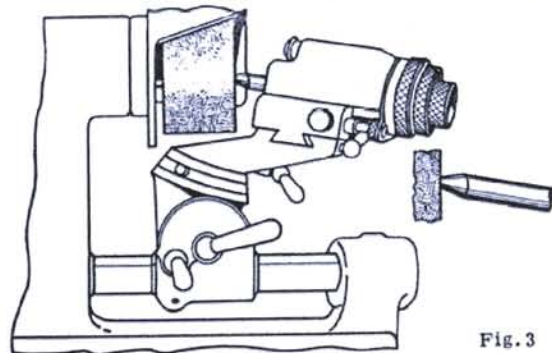


Fig. 3

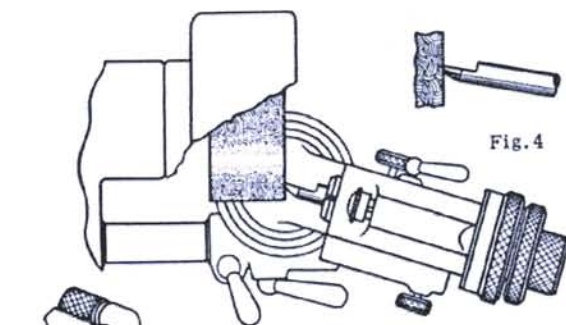


Fig. 4

#### Grinding the Back Rake Angle

5. Lateral fine adjustment of the work fixture relative to the grinding wheel and adjustment for depth of cut is obtained by means of screw F. It is also possible to grind the back rake angle manually; care should, however, be taken to produce the correct tool angles (see Fig. 5).

In cases where close tolerances on the small taper diameter after grinding the end cutting edge are prescribed, the corner of the side cutting edge will have to be maintained; this will make it possible to check whether or not the small taper diameter was changed during grinding operations (see Fig. 6).

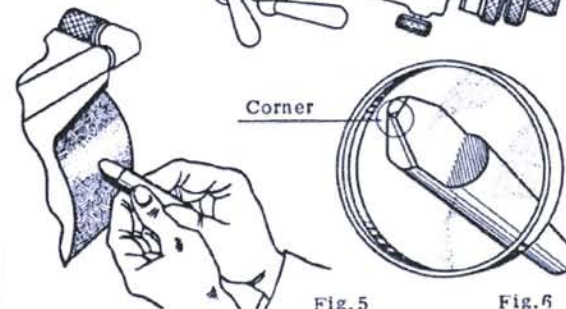


Fig. 5

Fig. 6

# Grinding Tapered Cutters -

## (C) Grinding the Back Angle of Side End Cutting Edges (Round)

Tapered cutters having either an off-center or an on-center radius can be given a back rake angle only in connection with the circular grinding operation (see Fig. 1). The back rake angle of the side cutting edge equals that of the straight or rounded end cutting edge; the proper angle to be used will be found in Page 6. After tapered cutters with rounded end cutting edges have become dull, first proceed with the circular grinding operation described in Page 12; then follow the procedure indicated below.

### Setup Operations

1. Engage index pin R into left-hand hole; bring red dot into window U.
2. Release clamping lever K2; use scale T2 to set work fixture at desired back rake angle; tighten clamping lever K2.
3. Tighten clamping lever K; release lever K1; shift work fixture along tubular rail to bring cutter into light contact with grinding wheel; tighten clamping lever K1, taking care to keep index mark of vertical swivel mount aligned with reference line on tubular rail; release clamping lever K, see Fig. 2.

### Grinding the Back Rake Angle

4. While continuously rotating the collet bearing through 180° (back and forth between the stops), advance the cutter towards the grinding wheel by means of fine adjustment screw F. This will produce the desired back rake angle on both the side and the end cutting edges in a positively controlled operation (see Figs. 3, 4, 5).

Upon completion of grinding operations a very narrow land must remain at the cutting edge.

5. In cases where the cutter is intended for the machining of hard steel which requires a small back rake angle, it is advisable to grind off part of the curvature in a manual operation (see Fig. 6).

In addition it is recommended, with regard to all single-lip cutters, to whet also the cutting lip by means of an oil stone in order to remove burrs. However, care should be exercised not to remove noticeable amounts of stock from the cutting lip, as this would destroy the centering of the lip; moreover, this would render a greater or lesser part of it useless.

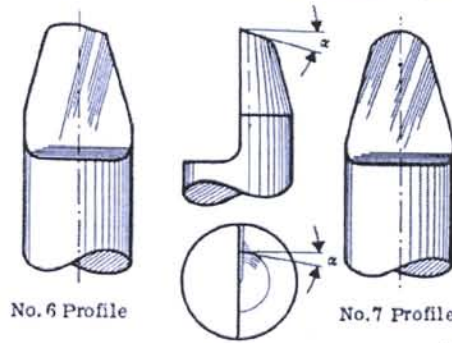


Fig. 1

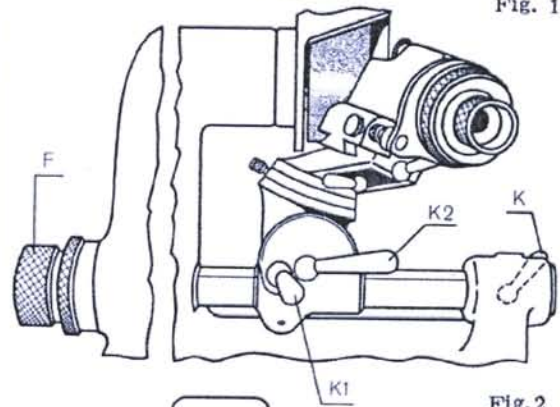


Fig. 2

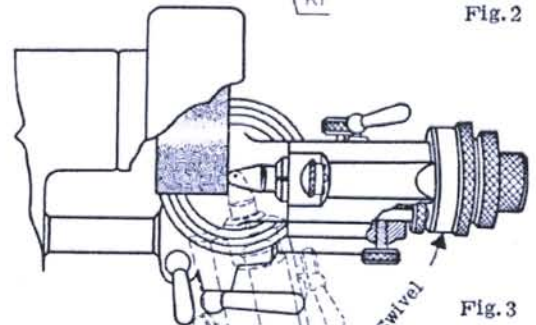


Fig. 3

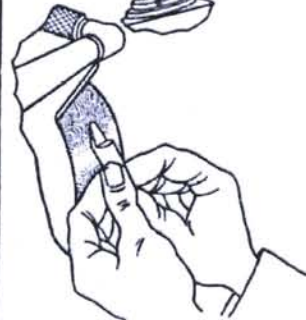
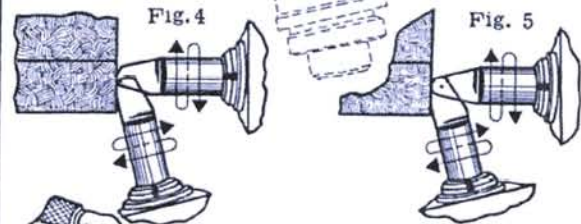


Fig. 6