David Brown / Templeton Tools
Expanding Floating Reamers

Master Manual

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1.0. INTRODUCTION

Reamers is the name given to a family of tools whose function is to improve the surface finish and geometry, whilst maintaining 'the required size of holes which have been pre-drilled. The holes are normally semi-finished by some form of boring operation. The holes may be parallel or tapered and with or without grooves (keyways etc.).

There are three main types of reamer:

1.1. Solid Reamer

The solid reamer may be either parallel or tapered and is normally supplied in 2 forms, one for use in hand reaming and the other for use in a machine tool. The flutes may be either straight or helical.

The hand reamer is used to improve the surface finish and roundness of the hole and, at the same time, ‘open’ it out to the required size. The reamer will normally follow the general alignment of the pre—drilled or semi—finished hole, although it will tend to align two holes which are in axial tandem.

The machine reamer is normally held in the tool station of machine tool and co—axial with the hole being reamed. Any misalignments in the machine tool will be reflected in the quality of hole being produced, resulting in one or more of the following faults.

a) Misalignment.
b) Oversize.
c) Out of round.

Solid machine reamers are useful where the hole is relatively small, and standard size, and particularly useful for tapered holes and those with grooves (Keyways, etc.).

They are manufactured in large quantities to suit particular bore sizes (where the consumption justifies) and cover both standard and non-standard size holes.

The solid reamer has limited life in that any wear which takes place on the periphery of the blades reduces its effective dimeter. Once the effective diameter drops below the minimum required hole size there is no alternative but to replace the reamer.

1.2. Expanding Reamer

In order to overcome the problem of maintaining size with a solid reamer the expanding reamer was developed. This type of reamer is also useful in producing non-standard size holes.

The reamer normally consists of a cage holding 5 or 6 blades round cone shaped central body. The effective outside diameter of the blades is either increased or decreased by moving the blade cage up or down the central cone using a system of adjusting nuts to move the and lock it firmly in position.

With this type of reamer, it is not normally possible to guarantee that all blades will move in or out the same amount as the diameter is changed. In order to overcome this problem, it in common practice to expand the blades to obtain nominal diameter about 0.002" greater than that required then spot grind the periphery of the blades to the required diameter thus ensuring that all blades take an equal share of the work. After the initial setting for size further minor adjustments can be made, to compensate for wear etc., using the system of adjusting nuts.

This process can be time consuming with the consequent incurring of costs and may have to be repeated on each new size setting within the range of the reamer. The expansion range of each size of reamer is limited and this results in a relatively large stock of reamers being required to cover given range of hole sizes.

One form of expanding reamer is of 'monobloc' construction with two or more blades on a body which is split to allow the effective diameter to be expanded. The expansion is controlled by the elasticity of the material in conjunction with a central socket screw having a tapered portion which fits in the tapered bore of the reamer body. Problems have arisen with this method of expanding the reamer, in that when the reamer has been locked at near maximum expansion for a period of time, it takes on a permanent set making it difficult if not impossible to adjust the reamer for smaller diameters.

Expanding reamers are available in wide variety of designs but all are based on the same principle which is to provide a cutting tool with two or more blades which can be expanded through a given size range. The reamers are manufactured for use in both machine and hand reaming. The problems caused by machine tool misalignments when using solid reamers also apply when using expanding, reamers. To offset the problem of machine tool misalignments special tool holders have been developed which allow the solid and expanding reamers to float. The required result is achieved by allowing the complete reamer to float in its holder and adopt a more balanced cutting position at each instant of rotation, thus minimising the effect of these errors.

One problem associated with floating holders is the tendency for the reamer to sag' when not cutting. This can be offset to some extent by the provision of a form of 'cradle' which limits the float.

1.3. Adjustable Floating Reamer

The need to produce holes to close limits of dimensional accuracy, with good surface finish, in a wide variety of ferrous and non—ferrous materials is a major requirement in virtually every area of engineering. There is a particular need to machine bores of sufficient quality to enable them to be used as accurate location bores for future machining operations. This requirement led to the development of reamers which incorporated the best features of the solid and expanding reamers in a single tool. One such tool is the David Brown Adjustable Floating Reamer.

Continued development has led to a range of tools designed specifically for high quality work where the requirement is for bores finished to fine limits of concentricity, parallelism and surface finish. In the David Brown Adjustable Floating Reamer, the blades are floating and can be adjusted to suit any diameter over a given range, thus incorporating the essential features of float and adjustability in a single tool.

In addition to these essential requirements the David Brown Adjustable Floating Reamer has a number or important features which enhance its value as a precision engineering tool. The reamer is robust but compact in construction and is characterised by its simplicity in use, whilst retaining all the features of a precision tool. The simplicity of the reamer is reflected in the tooling necessary for its adjustment and maintenance and is limited to a standard Allen key or small screwdriver for dismantling and re-assembling the reamer together with a suitable micrometer for the initial setting of the blades. The blades can be readily sharpened on a surface grinding machine without complicated jigs and fixtures although simple jigs may be useful where the quantity justifies. Several important features ensure the reamer meets the conditions necessary to maintain the required dimensional accuracy and surface- finish.

- The blades are floating and adjustable to suit any diameter within the range of the reamer.
- The float is constant and effective through the full range of the blade adjustment, and is pre-determined in the design.
- The blades are located in the reamer body in open slots which are closed by a removable end cap.

- The blades, slots and cap face are precision ground to ensure the blades have freedom of movement whilst retaining, stability in operation.
- When the blades are located in the reamer body, the cutting edges are diametrically opposed and the controlled location, together with the area of support, preclude the possibility of tilt in operation.
- The configuration of the blade cutting edge can be readily modified within certain limitations to suit particular applications.
- The reamer bodies are carefully proportioned to eliminate vibration in operation and have, as standard a morse taper shank integral with the body of the reamer.

The adjustment of the blades is positive in either direction and effected by complimentary rotation of the adjusting rings. Initially the blades are adjusted to obtain the required size which is determined using a suitable micrometer. The two adjusting rings are then locked firmly, and the blade setting verified using the micrometer. If further adjustment is required, then this is controlled using the scale on the adjusting dial ring. The adjusting rings are located on a fine thread cut in the reamer body thus permitting extremely fine blade adjustment to give any desired dimension within the range of the reamer.

The blades may be either solid High Speed Steel or tipped with Tungsten Carbide.

NOTE:

a) The David Brown Adjustable Floating Reamer cannot be used to ream holes which are either tapered or interrupted by keyways etc.
b) The reamer is designed to effectively rotate clockwise (looking from the shank end) relative to the component but can be supplied with a modified body and blades for effective anticlockwise rotation If required.
c) The reamers are supplied with an integral Morse Taper Shank as standard but the S and SL Types can be supplied with parallel shank as an alternative.

THE DAVID BROWN ADJUSTABLE FLOATING REAMER

2.0. DESCRIPTION

2.1. General

The reamer is manufactured in three forms and these are designated types SS, S and SL.

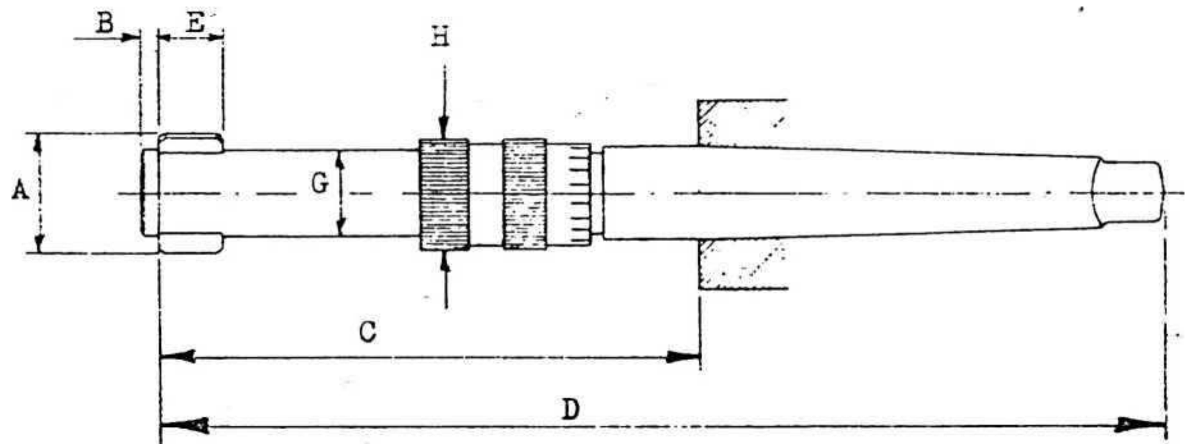
The three types are basically the same but vary in detail to suit particular sizes and applications.

SS - This is a series of 5 reamers (SS1 - SS5) covering a range of hole sizes from ½" to ¾" (12.70mm - 19.05mm) and are suitable for reaming through holes only.

S - This is a series of 18 reamers (SI — S18) covering a range of hole sizes from ¾" to 8" (19.00mm — 203.2mm.) and suitable for reaming through holes only.

SL - This is a series of 18 reamers (SL1 — SL18) covering a range of hole sizes from ¾" to 8" (19.00mm - 203.2mm) and suitable for reaming blind or stepped holes. In an emergency the SL type reamer can be used for reaming through holes but this practice in not to be encouraged as the special configuration of the blades, necessary for reaming blind or stepped holes, restricts their ability to centralise and align as the reamer enters the hole.

Dimensions of SS Type Reamers



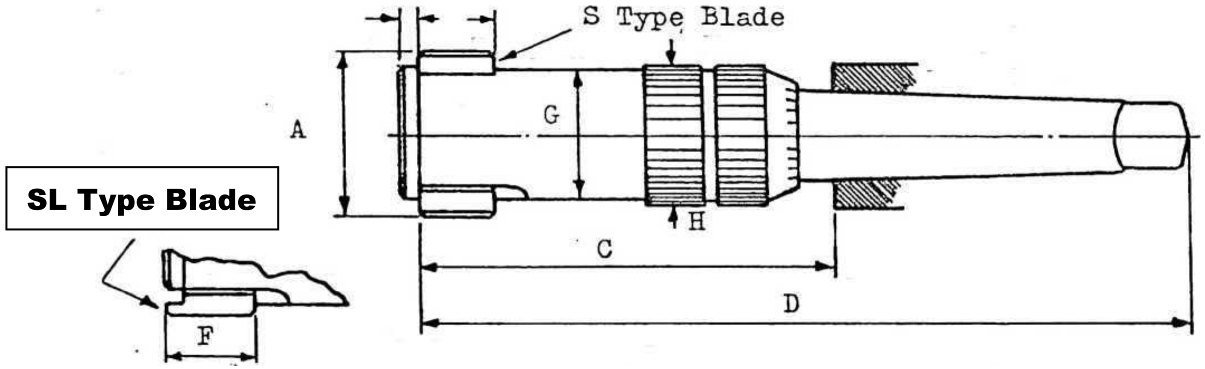
Dimensions of SS Type Reamers

Type & Size of Reamer	Dimensions in inches and millimetres								Morse Taper No.
	Range A		B	C	D	E	G	H	
	Min.	Max.							
SS1	0.500"	0.531"	0.08"	2.72"	5.16"	0.28"	0.4"	0.49"	1
	12.7mm	13.49mm	2.00mm	69.0mm	131.0mm	7.11mm	10.2mm	12.4mm	
SS2	0.531"	0.573"	0.08"	2.75"	5.19"	0.305"	0.4"	0.51"	1
	13.49mm	14.68mm	2.00mm	70.0mm	131.3mm	7.75mm	10.2mm	13.0mm	
SS3	0.578"	0.625"	0.08"	2.81"	5.25"	0.33"	0.440"	0.55"	1
	14.68mm	15.37mm	2.00mm	71.4mm	133.3mm	3.38mm	11.2mm	14.6mm	
SS4	0.625"	0.637"	0.10"	5.00"	5.44"	0.355"	0.43"	0.59"	1
	15.87mm	17.46mm	2.50mm	75.2mm	138.2mm	9.02mm	12.2mm	15.0mm	
SS5	0.637"	0.750"	0.10"	3.12"	5.56"	0.58"	0.51"	0.62"	1
	17.46m	19.05mm	2.50mm	79.2mm	141.2mm	9.65mm	13.0mm	15.7mm	

TABLE A.

Dimensions of S/SL Type Reamers

Note: The reamers are supplied with a Morse Taper Shank as standard but can be supplied with a parallel shank as an alternative.



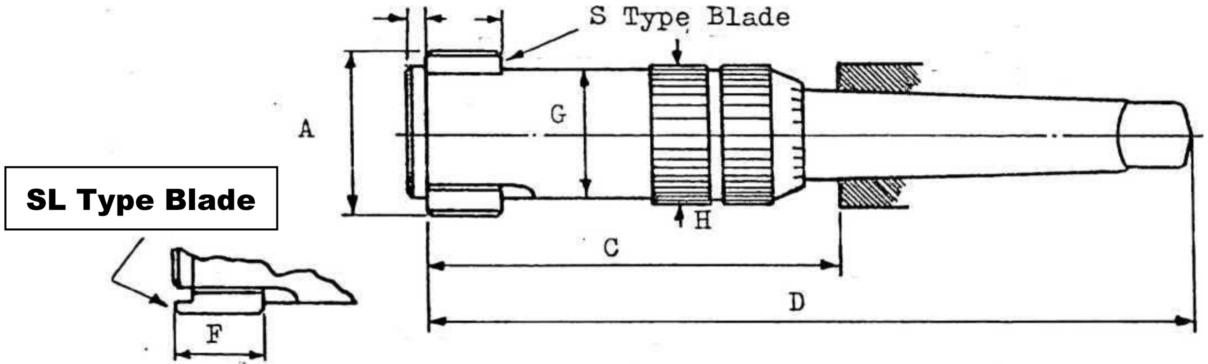
Dimensions of S - SL Type Reamers

Type & Size of Reamer	Dimensions in inches and millimetres.									Morse Taper No.	Max. Parallel Shank Dia.
	Range A		B	C	D	E	F	G	H		
	Min.	Max.									
S – SL 1	0.750”	0.812”	0.12”	2.25”	4.81”	0.410”	0.550”	0.69”	0.72”	1	0.469”
	19.0mm	20.6mm	3.2mm	57.2mm	122.2mm	10.4mm	14.0mm	17.5mm	18.3mm		11.9mm
S – SL 2	0.812”	0.875”	0.12”	2.25”	4.81”	0.410”	0.550”	0.72”	0.75”	1	0.469”
	20.6mm	22.2mm	3.2mm	57.2mm	122.2mm	10.4mm	14.0mm	18.3mm	19.0mm		11.9mm
S – SL 3	0.875”	0.937”	0.12”	2.44”	5.00”	0.450”	0.600”	0.80”	0.81”	1	0.500”
	22.2mm	23.8mm	3.2mm	61.9mm	127.0mm	11.4mm	15.2mm	20.2mm	20.6mm		12.7mm
S – SL 4	0.937”	1.000”	0.12”	2.44”	5.00”	0.450”	0.600”	0.84”	0.86”	1	0.500”
	23.8mm	25.4mm	3.2mm	61.9mm	127.0mm	11.4mm	15.2mm	21.4mm	21.8mm		12.7mm
S – SL 5	1.00”	1.125”	0.12”	2.94”	6.00”	0.550”	0.705”	0.91”	0.95”	2	0.687”
	25.4mm	28.6mm	3.2mm	74.6mm	152.4mm	14.0mm	17.9mm	23.0mm	24.2mm		17.5mm
S – SL 6	1.125”	1.250”	0.12”	2.94”	6.03”	0.550”	0.725”	1.00”	1.03”	2	0.750”
	28.6mm	31.8mm	3.2mm	74.6mm	153.2mm	14.0mm	18.4mm	25.4mm	26.2mm		19.0mm
S – SL 7	1.250”	1.375”	0.16”	3.31”	6.41”	0.625”	0.800”	1.12”	1.14”	2	0.750”
	31.8mm	34.9mm	4.0mm	84.1mm	162.7mm	15.9mm	20.3mm	28.6mm	29.0mm		19.0mm
S – SL 8	1.374”	1.500”	0.19”	3.31”	6.44”	0.625”	0.835”	1.25”	1.27”	2	0.750”
	34.9mm	38.1mm	4.8mm	84.1mm	163.5mm	15.9mm	21.2mm	31.8mm	32.1mm		19.0mm
S – SL 9	1.500”	1.750”	0.19”	3.94”	7.81”	0.780”	1.000”	1.38”	1.41”	3	0.937”
	38.1mm	44.4mm	4.8mm	100.0mm	198.4mm	19.8mm	25.4mm	34.9mm	35.7mm		23.8mm

TABLE B.

Dimensions of S/SL Type Reamers

Note: The reamers are supplied with a Morse Taper Shank as standard but can be supplied with a parallel shank as an alternative.



Dimensions of S - SL Type Reamers - TABLE C.

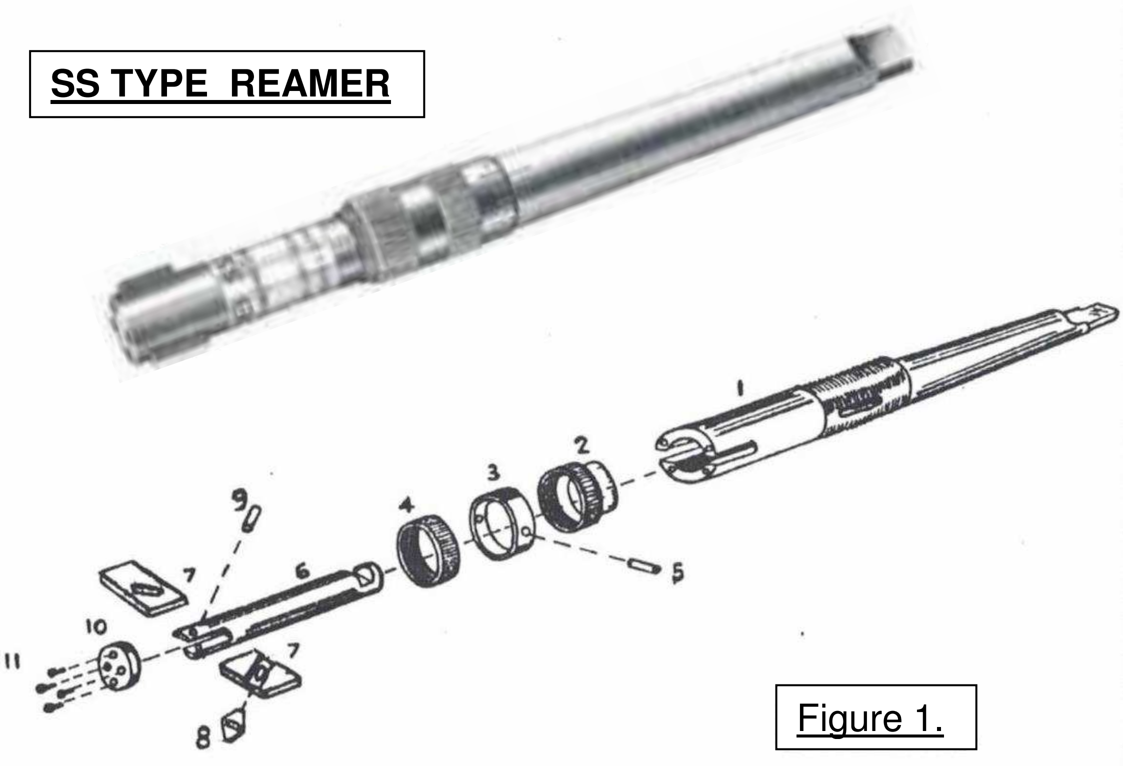
Type & Size of Reamer	Dimensions in inches and millimetres.									Morse Taper No.	Max. Parallel Shank Dia.
	Range A		B	C	D	E	F	G	H		
	Min.	Max.									
S – SL 10	1.750”	2.000”	0.22”	4.06”	7.94”	0.875”	1.105”	1.56”	1.61”	3	1.125”
	44.4mm	50.8mm	5.6mm	103.2mm	201.6mm	22.2mm	28.1mm	39.7mm	40.9mm		28.6mm
S – SL 11	2.000”	2.375”	0.25”	4.44”	9.31”	1.050”	1.325”	1.81”	1.88”	4	1.250”
	50.8mm	60.3mm	6.3mm	112.7mm	236.5mm	26.7mm	33.7mm	46.0mm	47.6mm		31.8mm
S – SL 12	2.375”	2.750”	0.25”	4.50”	9.38”	1.050”	1.325”	2.12”	2.16”	4	1.500”
	60.3mm	69.8mm	6.3mm	114.3mm	238.1mm	26.7mm	33.7mm	54.0mm	54.8mm		38.1mm
S – SL 13	2.750”	3.250”	0.25”	5.00”	9.88”	1.250”	1.530”	2.44”	2.50”	4	1.500”
	69.8mm	82.5mm	6.3mm	127.0mm	250.8mm	31.8mm	38.9mm	61.9mm	63.5mm		38.1mm
S – SL 14	3.250”	4.000”	0.31”	5.88”	10.81”	1.438”	1.790”	2.88”	2.94”	4	2.000”
	82.5mm	101.6mm	7.9mm	149.2mm	274.6mm	36.5mm	45.5mm	73.0mm	74.6mm		50.8mm
S – SL 15	4.000”	5.000”	0.38”	6.88”	13.12”	1.750”	2.165”	3.62”	3.38”	5	2.125”
	101.6mm	127.0mm	9.5mm	174.6mm	333.4mm	44.5mm	55.0mm	92.1mm	85.7mm		54.0mm
S – SL 16	5.000”	6.000”	0.38”	6.88”	13.12”	1.750”	2.165”	4.50”	3.38”	5	2.125”
	127.0mm	152.4mm	9.5mm	174.6mm	333.4mm	44.5mm	55.0mm	114.3mm	85.7mm		54.0mm
S – SL 17	6.00”	7.000”	0.38”	7.50”	13.75”	2.000”	2.415”	5.50”	4.25”	5	2.625”
	152.4mm	177.8mm	9.5mm	190.5mm	349.3mm	50.8mm	61.3mm	139.7mm	108.0mm		66.7mm
S – SL 18	7.000”	8.000”	0.38”	7.50”	13.75”	2.000”	2.415”	6.50”	4.25”	5	2.625”
	177.8mm	203.2mm	9.5mm	190.5mm	349.3mm	50.8mm	61.3mm	165.1mm	108.0mm		66.7mm

TABLE C

2.2. SS Type

The SS type reamer is manufactured in 5 sizes which are geometrically similar.

The reamer consists of 15 parts. These are defined in FIG. 1.



SS TYPE REAMER

Figure 1.

Key to Figure 1

1. Body
2. Adjusting Dial Ring
3. Collar
4. Adjusting Lock Nut
5. Transverse Pin
6. Plunger
7. Blades (2)
8. Rhomboidal Key
9. Float Limiting Pin
10. End Cap
11. Screws

2.2.1. Identification Of Parts – SS Type

On occasions it may be convenient to establish which type and of reamer particular spare part will fit.

In order to fulfil this requirement, identifying dimensions have been established for each part of the reamer, except the body which can be identified by size of End Cap (Table 10).

All similar parts having the same identifying dimensions can be considered identical.

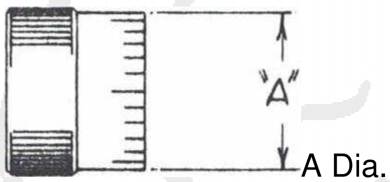
The identifying dimensions for each part of the SS type reamers are contained in the illustrated tables 2 to 11 inclusive.

The table number also refers to the part number defined in Figure 1.

The tables are used in the following manner:

> Referring to table 2: an Adjusting Dial Ring having an identifying dimension of 0.468 ins (11.9 mm) is suitable for an SS1 reamer.

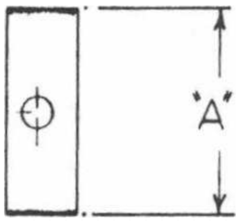
DIAL RING



SIZE SS	"A"	
	Inch	mm
1	0.468	11.9
2	0.493	12.5
3	0.533	13.5
4	0.573	14.6
5	0.603	15.3

TABLE 2.

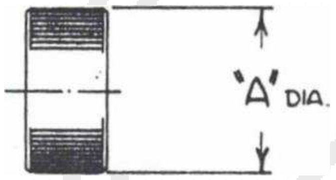
COLLAR



SIZE SS	"A"	
	Inch	mm
1	0.489	12.4
2	0.491	12.5
3	0.531	13.5
4	0.571	14.5
5	0.601	15.3

TABLE 3

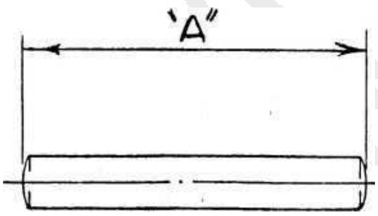
ADJUSTING LOCK RING



SIZE SS	"A"	
	Inch	mm
1	0.488	12.4
2	0.513	13.0
3	0.553	14.0
4	0.593	15.1
5	0.623	15.8

TABLE 4

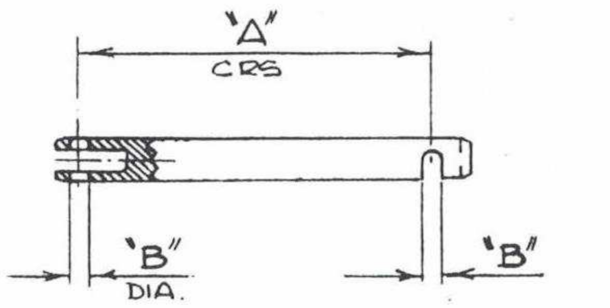
TRANSVERSE PIN



SIZE SS	"A"	
	Inch	mm
1	0.491	12.5
2	0.509	12.9
3	0.549	13.9
4	0.589	15.0
5	0.619	15.7

TABLE 5

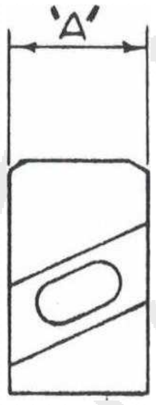
PLUNGER



SIZE SS	"A"		"B"	
	Inch	mm	Inch	mm
1			0.062	1.57
2			0.078	1.98
3	1.535	39.0		
4	1.686	42.8		
5	1.799	45.7		

TABLE 6

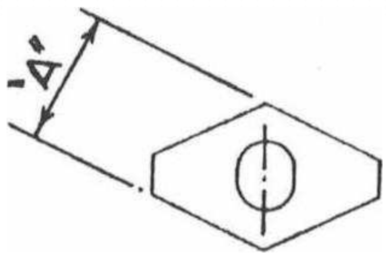
BLADES



SIZE SS	"A"	
	Inch	mm
1	0.280	7.1
2	0.305	7.7
3	0.330	8.4
4	0.355	9.0
5	0.380	9.7

TABLE 7

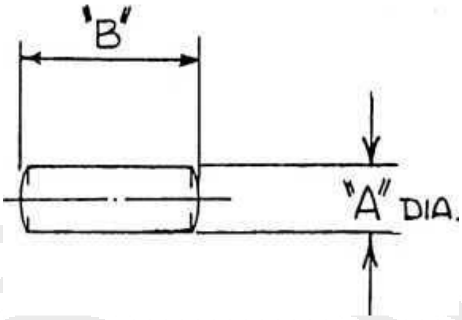
RHOMBOIDIAL KEY



SIZE SS	"A"	
	Inch	mm
1	0.150	3.8
2 & 3	0.180	4.6
4 & 5	0.200	5.1

TABLE 8

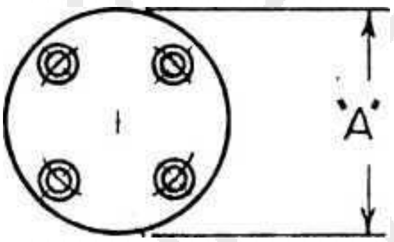
FLOAT LIMITING PIN



SIZE SS	"A"		"B"	
	Inch	mm	Inch	mm
1	0.062	1.57	0.194	4.9
2 & 3	0.078	1.98	0.194	4.9
4 & 5	0.093	2.36	0.244	6.2

TABLE 9

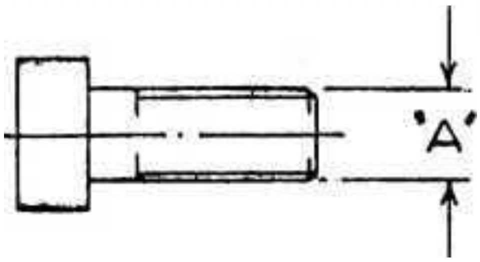
END CAP



SIZE SS	"A"	
	Inch	mm
1 & 2	0.400	10.2
3	0.442	11.2
4	0.482	12.2
5	0.512	13.0

TABLE 4

SCREWS



SIZE SS	"A"	
	Inch	mm
1, 2, 3, 4 & 5	0.05	1.3

TABLE 11

2.2.2. Dismantling the Reamer – SS Type

1. Remove the End Cap using a small screwdriver to loosen the Screws.
2. Cause the Plunger to protrude from the Body by complimentary rotation (clockwise looking from shank end) of the Adjusting Rings. Continue the rotation until the Float Limiting Pin is clear of the Body.
3. Press out the Float Limiting Pin and withdraw the Blades, complete with Rhomboidal Key, from the Plunger.
4. Separate the Blades and remove the Rhomboidal Key
5. Remove the Transverse Pin by using a small punch, to gently drift the pin from the Collar. Take care not to damage the Collar or Pin.
6. Withdraw the Plunger.
7. Remove the Adjusting Rings and Collar by rotating the rings in a clockwise direction (looking from the shank end).

Note: If the reamer is being dismantled to enable the blades to be sharpened or replaced, follow the above procedure up to and including paragraph 4.

2.2.3. Assembling the Reamer - SS Type

1. Check each component part of the reamer to ensure there are no burrs which may affect the float and adjustment of the Blades. If any burrs are found, they must be removed using a dressing stone. Care must be taken to ensure that remedial work does not adversely affect the accuracy of the reamer. Lightly lubricate all moving parts with a suitable light machine oil.
2. Thread the Adjusting Dial Ring, graduations first, over the blade end of the body and locate on the thread (Right Hand) towards the shank end leaving adequate space on the threaded portion for the Collar and Adjusting Lock Ring.
3. Thread the collar over the blade end of the body, noting direction of offset (See Figure 2) and follow with the Adjusting Lock Ring. Align the holes in the Collar with the transverse pin slot which is cut in the body. Using the Adjusting Rings, lightly clamp the collar in position.

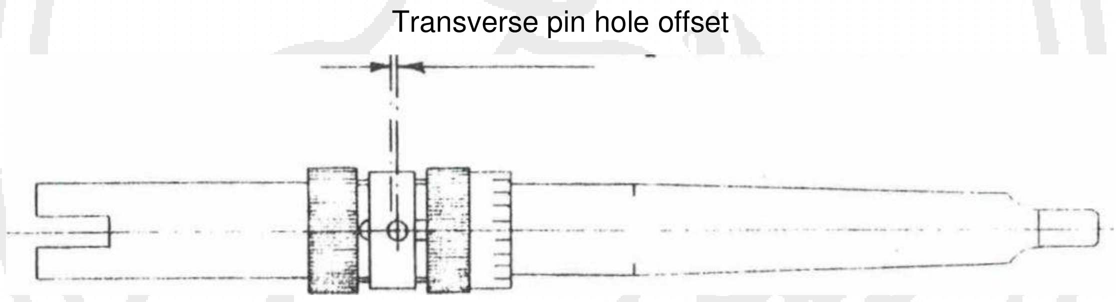


FIG. 2.

4. Insert the Plunger, transverse pin slot first, into the body and align the slot with the holes in the Collar.
5. Insert the Transverse Pin and locate it in the two holes in the Collar. When correctly fitted the ends of the Transverse Pin should be flush with the periphery of the Collar and pass through the cut in the Body and Plunger. The Transverse Pin is an interference fit in the Collar hole and will require drifting to position using a suitable small hammer and drift. Care must be taken to ensure the Collar and Transverse Pin are not damaged in this operation.

6. Cause the Plunger to protrude from the Body by complimentary rotation (clockwise looking from shank end) of the Adjusting Rings. Continue rotation until the float limiting pin hole is clear of the Body.
7. Take one Blade and place the Rhomboidal Key into the slot which is cut in the Blade. Ensure the key slides smoothly in the slot and is correctly aligned. The elongation of the keyhole must run normal to the cutting edge of the blade (See Figure 3).

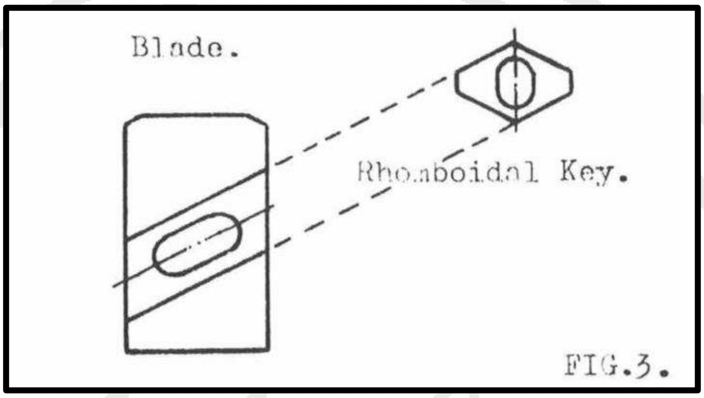


FIG.3.

8. Place the second Blade on the first so that the Rhomboidal Key locates in the slot cut in the Blade, and the cutting edges are diametrically opposed. Ensure the Blades slide smoothly together whilst the Key is located in the slots.

9. Insert the Blade assembly into the slot cut in the Plunger and align the elongated hole, in the Rhomboidal Key, with the holes in the Plunger. Care must be taken to correctly orientate the Blades in the Plunger. (See Figure 4).

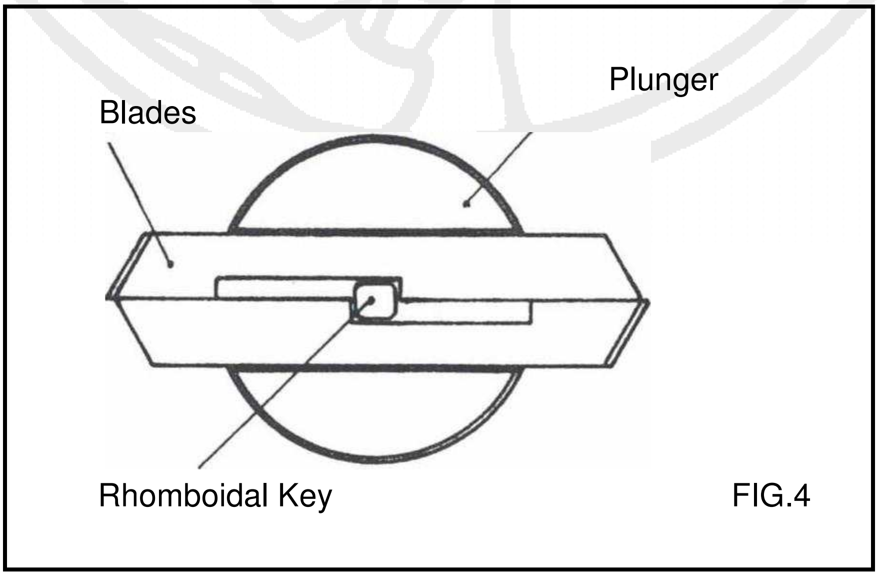
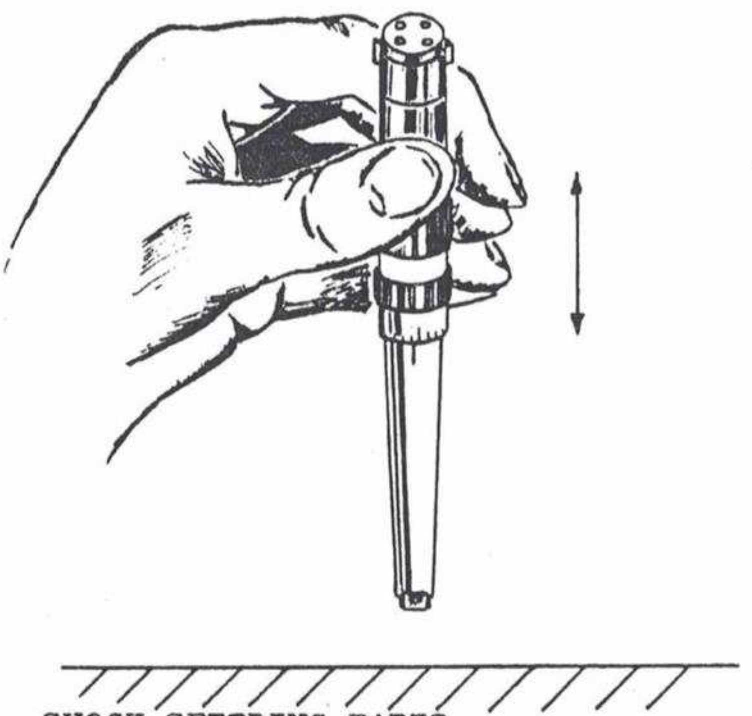


FIG.4

10. Insert the Float Limiting Pin to locate in the holes in the Plunger. When correctly fitted the ends of the Float Limiting Pin should be flush with the periphery of the Plunger. The Float Limiting Pin is a sliding fit in the Plunger and requires only finger pressure when fitting.
11. Withdraw the Plunger into the Body by complimentary rotation (anticlockwise looking from shank end) of the Adjusting Rings. Continue rotation until the blade assembly can be pressed into the slots in the body to allow the End Cap to be fitted.
12. Fit the End Cap using a small screwdriver to insert and tighten the screws.
13. Tap the shank end of the reamer sharply then check the Screws for tightness and re-tighten if necessary (See figure 5).



SHOCK SETTLING PARTS
AFTER REAMER ASSEMBLY. FIG.5.

14. Check the adjusting mechanism and the blade float to ensure the movements are free but precise.
15. The reamer will then be ready for use, after setting the Blades to suit the required hole size.

NOTE: If the reamer has been only partially dismantled to replace, or sharpen, the Blades then use paragraphs 1 and 7 to 15 inclusive.

2.3. S-Type Reamers

The S type reamer is manufactured in 18 sizes which are basically similar but take two forms:

1. S1 - S15 have cylindrical bodies and are all geometrically similar.
2. S16 - S18 have cylindrical bodies which have been flatted to reduce weight whilst retaining the required blade support. The 3 sizes are geometrically similar.

The reamers consist of 15 parts and these are defined in Figures 6 and 7.

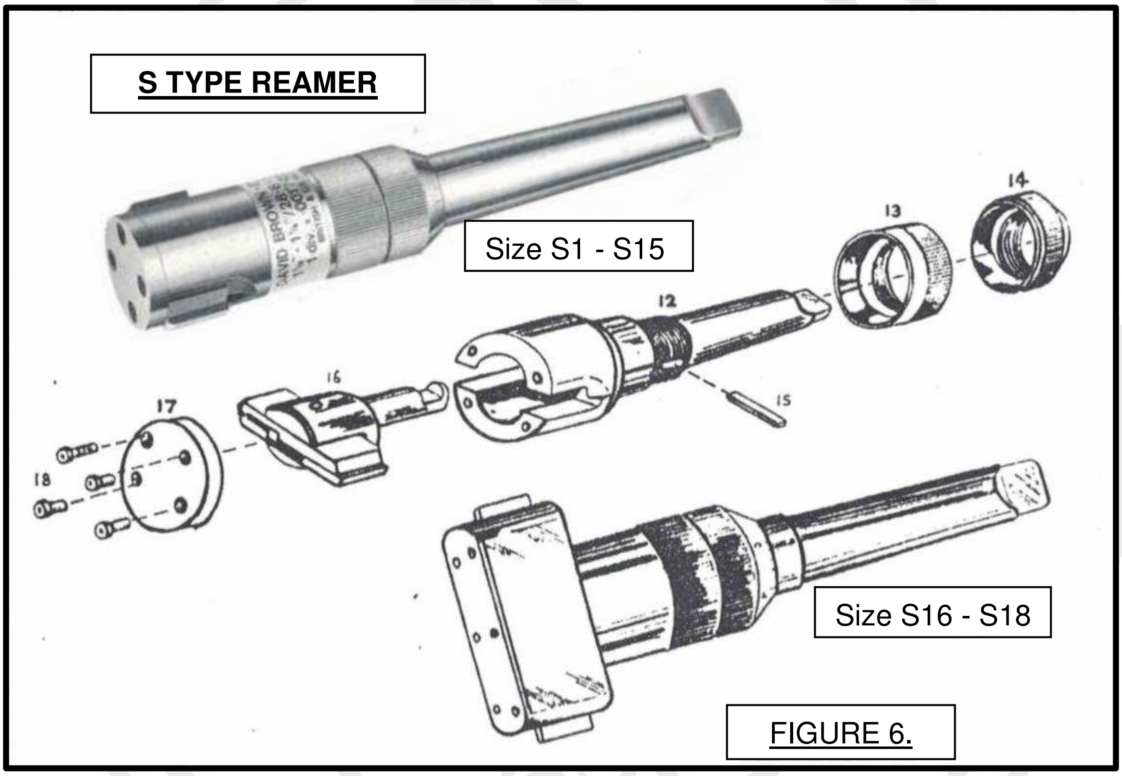
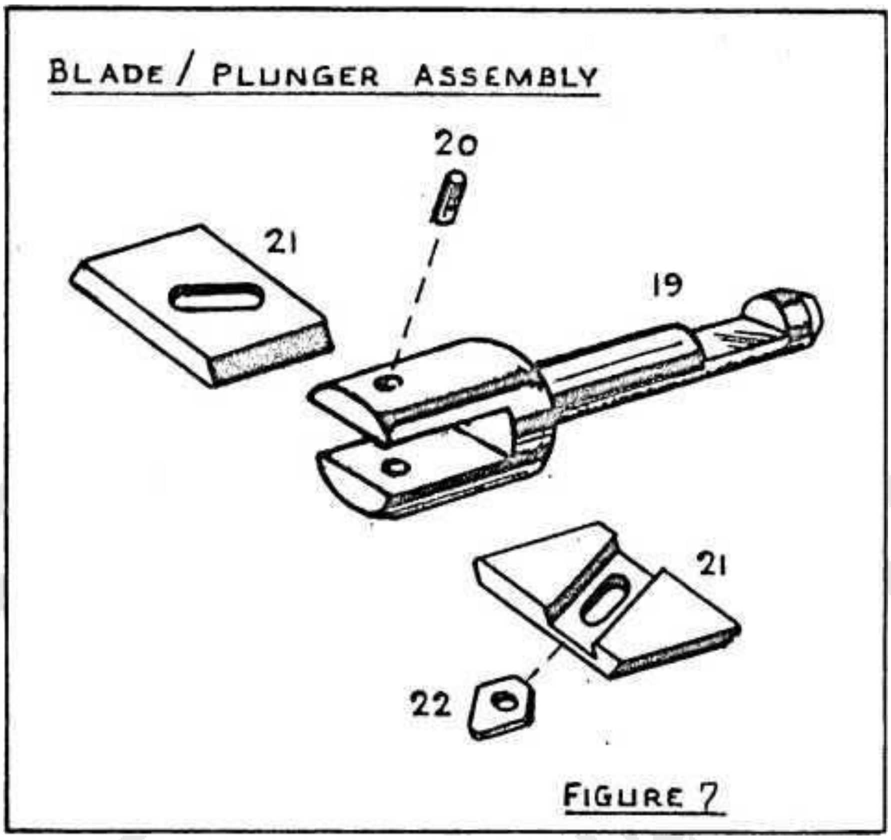


FIGURE 6.

Key to Figure 6

12. Body
13. Adjusting Lock Ring
14. Adjusting Dial Ring
15. Transverse Key
16. Blade/Plunger assembly
17. End Cap
18. Screws (4 or 6)



Key to Figure 7

12. Plunger
13. Float Limiting Pin
14. Blades (2)
15. Rhomboidal Key

2.3.1. Identification of Parts – S Type

On occasions it may be convenient to establish which type and size of reamer a particular spare part will fit. In order to fulfil this requirement, identifying dimensions have been established for each part of the reamer, except the body which can be identified by size of End Cap (Table 17).

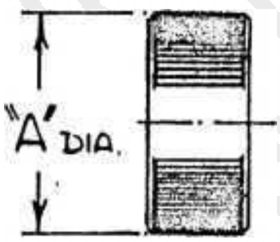
All similar parts having the same identifying dimensions can be considered identical. The identifying dimensions for each part of the S-Type reamers are contained in the illustrated tables 13 to 15 and 17 to 22 inclusive.

The table number also refers to the part number defined in Figs. 6 & 7.

The tables are used in the following manner:

> Referring to Table 13, an Adjusting Lock Ring having an identifying dimension of 0.722" (18.3mm) is suitable for an S1 reamer.

ADJUSTING LOCK RING



SIZE S	"A"	
	Inch	mm
1	0.722	18.3
2	0.742	18.8
3	0.812	20.6
4	0.858	21.8
5	0.952	24.2
6	1.022	26.0
7	1.142	29.0
8	1.272	32.3
9	1.402	35.6
10	1.608	40.8
11	1.868	47.4
12	2.158	54.8
13	2.512	63.8
14	2.938	74.6
15 & 16	3.358	85.3
17 & 18	4.254	108.1

TABLE 13.

ADJUSTING DIAL RING

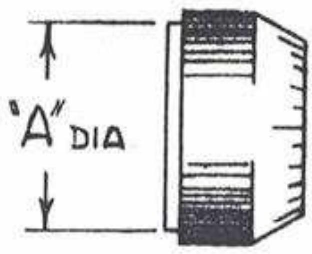


TABLE 14.

SIZE S	"A"	
	Inch	mm
1	0.665	16.9
2	0.675	17.1
3	0.740	18.8
4	0.760	19.3
5	0.895	22.7
6	0.942	23.9
7	1.055	26.8
8	1.158	29.4
9	1.278	32.5
10	1.492	37.9
11	1.718	43.7
12	1.998	50.7
13	2.302	58.5
14	2.688	68.3
15 & 16	2.988	75.9
17 & 18	3.738	94.9

TRANSVERSE KEY

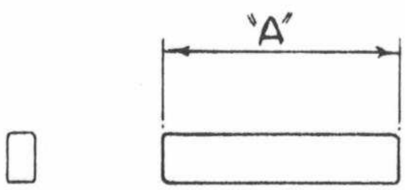
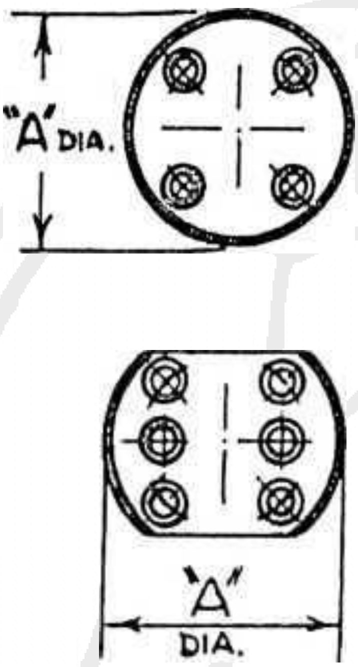


TABLE 15.

SIZE S	"A"	
	Inch	mm
1 & 2	0.609	15.5
3 & 4	0.672	17.1
5	0.836	21.2
6	0.852	21.6
7	0.969	24.6
8	1.016	25.8
9	1.132	28.7
10	1.348	34.2
11	1.532	38.9
12	1.813	46.0
13	2.062	52.4
14	2.390	60.7
15 & 16	2.546	64.7
17 & 18	3.156	80.2

END CAP

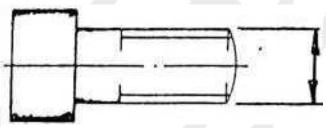


SIZE S	"A"	
	Inch	mm
1	0.680	17.3
2	0.725	18.4
3	0.795	20.2
4	0.840	21.3
5	0.900	22.9
6	1.000	25.4
7	1.125	28.6
8	1.250	31.8
9	1.375	34.9
10	1.562	39.7
11	1.812	46.0
12	2.125	54.0
13	2.437	61.9
14	2.875	73.0
15	3.625	92.1
16	4.500	114.3
17	5.500	139.7
18	6.500	165.1

TABLE 17.
(Also see Note on page 27)

SCREWS

TABLE 18. (Also see Note on page 24)



SIZE S	"A"		REMARKS
	Inch	mm	
1	0.075	1.9	Pre-change, unmarked caps
1	0.087	2.2	Post-change, marked caps
2, 3, 4, 5	0.087	2.2	
6 & 7	0.098	2.5	Pre-change, unmarked caps
6 & 7	0.110	2.8	Post-change, marked caps
8 & 9	0.110	2.8	
10	0.142	3.6	
11, 12 &13	0.185	4.7	
14	0.250	6.3	
15, 16, 17 & 18	0.312	7.9	Pre-change, unmarked caps
15, 16, 17 & 18	0.312	7.9	Post-change, marked caps

PLUNGER

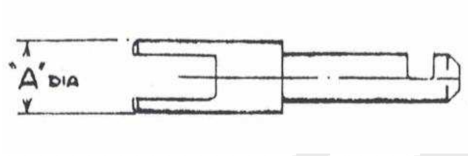


TABLE 19.

SIZE S	"A"	
	Inch	mm
1 & 2	0.375	9.5
3 & 4	0.437	11.1
5 & 6	0.500	12.7
7 & 8	0.625	15.8
9	0.812	20.6
10	0.875	22.2
11	1.000	25.4
12	1.200	30.5
13	1.400	35.5
14	1.700	43.2
15 & 16	2.000	50.8
17 & 18	2.500	63.5

FLOAT LIMITING PIN

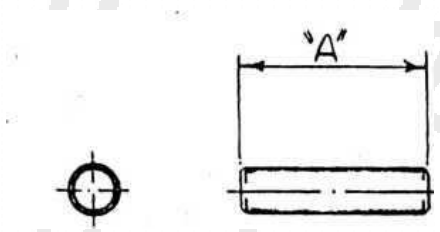
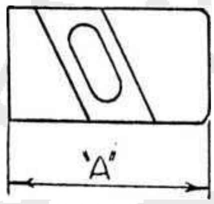


TABLE 20.

SIZE S	"A"	
	Inch	mm
1 & 2	0.350	8.9
3 & 4	0.410	10.4
5 & 6	0.475	12.1
7 & 8	0.595	15.1
9	0.780	19.8
10	0.835	21.2
11	0.965	24.5
12	1.156	29.3
13	1.360	34.6
14	1.671	42.4
15 & 16	1.938	49.3
17 & 18	2.407	61.2

BLADES

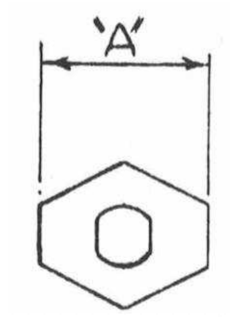
TABLE 21.



SIZE S	"A"	
	Inch	mm
1	0.692	17.6
2	0.745	18.9
3	0.805	20.4
4	0.865	22.0
5	0.935	23.7
6	1.055	26.8
7	1.175	29.8
8	1.295	32.9
9	1.425	36.2

SIZE S	"A"	
	Inch	mm
10	1.665	43.3
11	1.905	48.4
12	2.272	57.7
13	2.642	67.1
14	3.132	79.6
15	3.892	98.9
16	4.805	122.0
17	5.743	145.9
18	6.743	171.3

RHOMBOIDAL KEY



SIZE S	"A"	
	Inch	mm
1 & 2	0.406	10.3
3, 4, 5 & 6	0.437	11.1
7 & 8	0.500	12.7
9	0.625	15.8
10 & 11	0.750	19.0
12, 13 & 14	0.875	22.2
15 & 16	1.000	25.4
17 & 18	1.093	27.7

TABLE 22.

NOTE:

In 1977 a number of minor changes were implemented due to the rationalisation of the range of screws used to hold the end caps. These were made to enable screws to be used which are available from stock and in the preferred size range.

The consequence of this is that some types of bodies are now tapped to suit different thread forms, together with minor changes to the end caps, to accommodate the different screws.

The screws can be easily identified using the dimensions given in Table 18 and all end caps which are of modified design are marked with the relevant thread form. (i.e. S1 marked 8 BA).

2.3.2. Dismantling the Reamer – S Type

1. Rotate the Adjusting Lock Ring clockwise and Adjusting Dial Ring Anticlockwise (looking from the shank end) until there is sufficient space, between the two, to remove the Transverse Key.
2. Remove the Transverse Key. The key is a sliding fit and only requires light pressure to remove.
3. Remove the End Cap using a suitable Allen Key to loosen the screws.
4. Withdraw the Blade/Plunger assembly complete.
5. Press out the Float Limiting Pin and withdraw the Blades (complete with Rhomboidal Key) from the Plunger. The Pin is a sliding fit and requires only light pressure to remove.
6. Separate the Blades and remove the Rhomboidal Key.
7. Remove the Adjusting Rings by rotating the rings in an anticlockwise direction (looking from the shank end)

Note:

If the reamer is being dismantled to enable the blades to be sharpened or replaced, follow the above procedure up to and including paragraph 6.

2.3.3. Assembling the Reamer – S Type

1. Check each component of the reamer to ensure there are no burrs which affect the float and adjustment of the Blades. If any burrs are found they must be removed using a dressing stone but care be taken to ensure that any remedial work does not adversely affect the accuracy of the reamer. Lightly lubricate all moving parts with a suitable light machining oil.
2. Thread the Adjusting Lock Ring (plain end first) over the shank end and locate on the thread (Right Hand).
3. Thread the Adjusting Dial Ring (knurled end first) over the shank and locate on the thread.
4. Position the Adjusting Rings so as to leave adequate space between them to fit the Transverse Key.
5. Take one Blade and place the Rhomboidal Key into the slot which is cut in the blade. Ensure the Key slides smoothly in the slot and is correctly aligned. The elongation of the keyhole must run normal to the cutting edge of the Blade (See Figure 8).

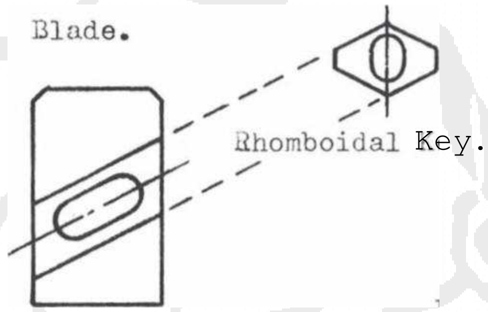


FIG.8.

6. Place the second Blade on the first so that the Rhomboidal Key locates in the slot cut in the Blade when the cutting edges are diametrically opposed. Ensure the Blades glide smoothly together whilst the Key is located in the slots.
7. Insert the Blade/Rhomboidal Key assembly into the slot cut in the Plunger and align the elongated hole, in the Rhomboidal Key, with the holes in the Plunger. Care must be taken to correctly orientate the Blades in the Plunger, (See figure 9).

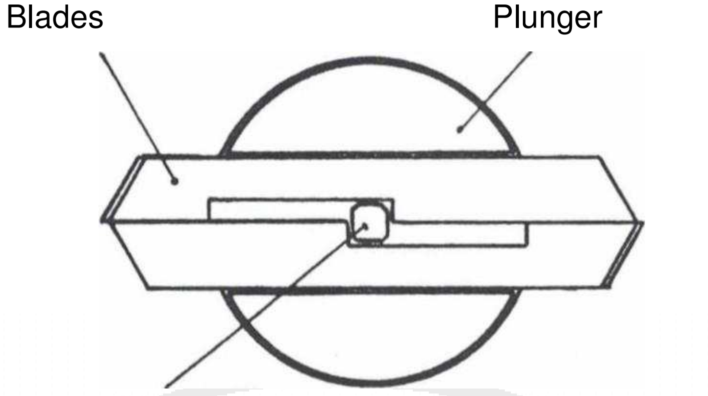
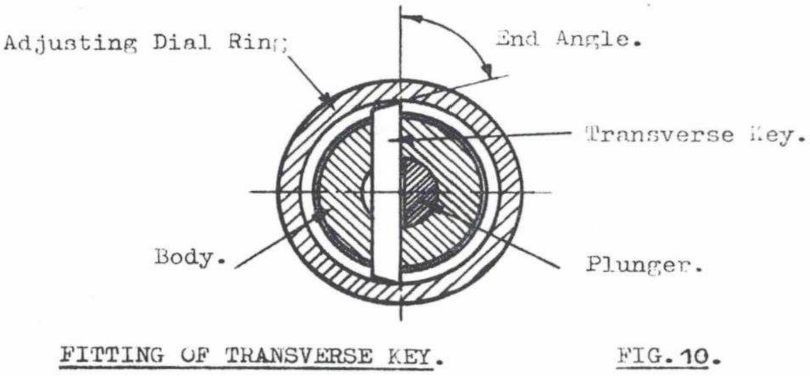


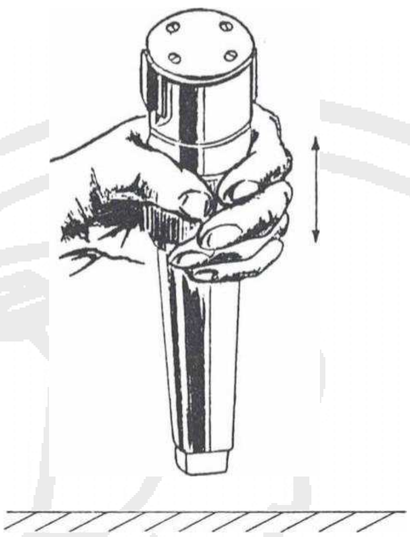
FIG.9.

8. Insert the Float Limiting Pin to locate in the holes in the Plunger. When correctly fitted the ends of the Float Limiting Pin should be flush with the periphery of the Plunger. The Float Limiting Pin is a sliding fit in the Plunger and requires only finger pressure when fitting.
9. Insert the Blade assembly, Transverse Key slot first, into the body and align the slot with the slots cut in the Body and the space between the Adjusting Rings.
10. Insert the Transverse Key to pass through the slots in the Body and the Plunger. Due to the slots being offset to the centre line of the reamer the Transverse Keys, on sizes 1 to 7 inclusive, are angled at the ends to follow the location diameter in the Adjusting Dial Ring and care must be taken to ensure the Key is fitted the correct way round. When correctly fitted the ends of the Transverse Key should protrude an equal amount each side of the body with the angled ends following the diameter. (The Transverse Keys on size 8 to 18 inclusive are square ended). The recessed location bore of the Adjusting Dial Ring should fit cleanly over the Key when the Adjusting Rings are rotated to close the gap between them. The Transverse Key is a sliding fit in the Plunger Slot and requires only finger pressure when fitting. (See figure 10).



FITTING OF TRANSVERSE KEY. FIG. 10.

11. Fit the End Cap using a suitable Allen Key to insert and tighten the screws.
12. Tap the shank end of the reamer sharply to locate the Blades and End Cap then check Screws for tightness and re-tighten if necessary (See figure 11).



SHOCK SETTLING PARTS
AFTER REAMER ASSEMBLY. Fig.11.

13. Check the adjusting mechanism and the blade float to ensure the movements are free but precise.
14. The reamer will then be ready for use, after setting the Blades to suit the required hole size.

NOTE:

If the reamer has been only partially dismantled to replace or sharpen the Blades, then use paragraphs 1 and 5 to 15 only.

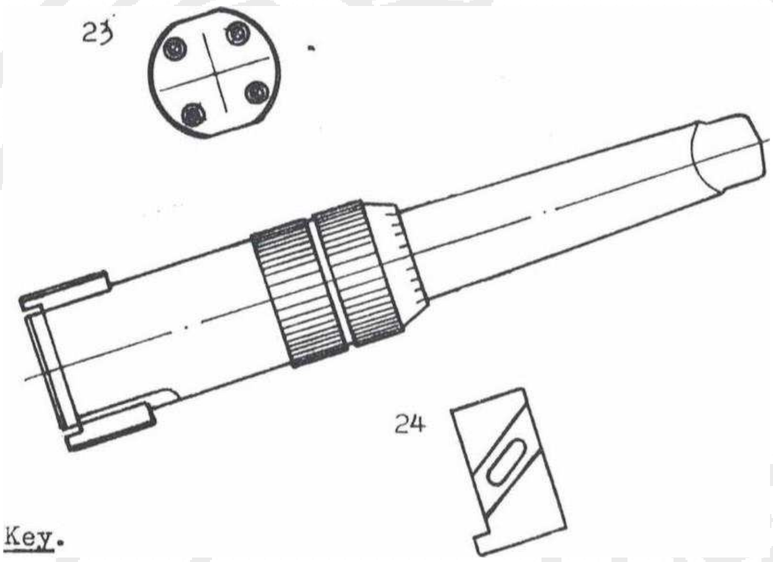
2.4. SL Type Reamers

These reamers are specially designed for the reaming of stepped and blind holes. Each reamer in the SL type range is identical to the equivalent reamer in the S type range apart from the Blades and End Cap.

The Blades are extended to protrude beyond the front of the reamer and are denoted “L” shaped Blades.

The End Cap is flatted to accommodate the Blade protrusion (See Figure 12).

SL TYPE REAMER.



23 - End Cap.

24 - Blade. FIG. 12.

The arrangement of the SL type reamer is identical to that of the S Type and this is illustrated in figures 6 and 7 (pages 18 and 19).

An SL type reamer can be easily converted to an S type reamer or vice versa by fitting the relevant Blades and End Cap.

S type Blades should not normally be used with a flatted End Cap ag this results in the reamer being more vulnerable to incursion of dirt and swarf.

The ease with which the S and SL type reamers can be converted may be an important feature, particularly for the small engineering shops where the time lost in converting a reamer is offset by the fact that it is only necessary to hold one complete S type reamer for each size in the range, together with an equivalent range of flatted End Caps and L Shaped Blades. Each reamer can then be assembled as either type (S or SL). This can be an obvious advantage to the small user on the grounds of economy and storage of tooling.

The large user would normally find it more convenient to stock both types of reamer complete, or where the reamer is used for specific operations, it may be sufficient to hold just the one type of reamer of the required size range.

NOTE: L shaped Blades are not available for the SS type reamers.

2.4.1. Identification of Parts - SL Type Reamers

The parts of the SL type reamer are identical to those of the equivalent reamer in the S type range apart from the Blades and End Cap.

Where it is necessary to establish which type and size of reamer a particular part will fit, then reference should be made to the section on Identification of Parts for S type reamers starting on Page 20.

The relevant illustrated tables are as listed in Table D.

Table Number	Part
13	Adjusting Lock Ring
14	Adjusting Dial Ring
15	Transverse Key
18	Screws
19	Plunger
20	Float Limiting Pin
22	Rhomboidal Key

TABLE D.

These table numbers also refer to the part number defined in figures 6 and 7.

The identifying dimensions for the End Cap and Blades are contained in the illustrated tables 23 and 24 respectively. These table numbers also refer to the part number defined in figure 12.

SL END CAP

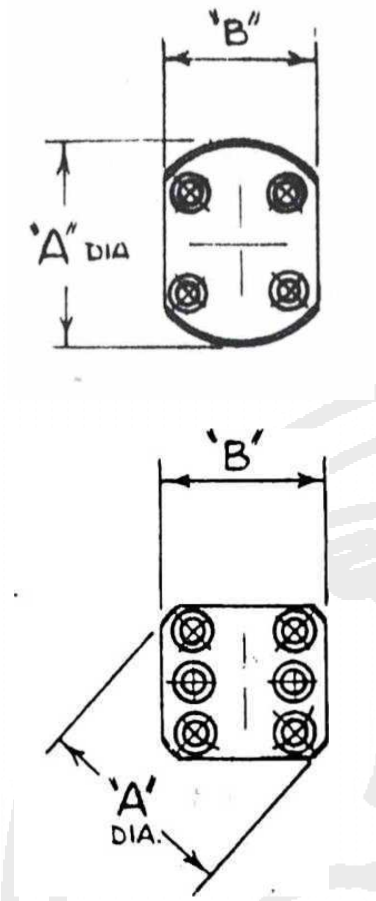


TABLE 23.

SIZE SL	"A"		"B"	
	Inch	mm	Inch	mm
1	0.680	17.3	0.522	13.3
2	0.725	18.4	0.562	14.3
3	0.795	20.2	0.612	15.6
4	0.840	21.3	0.660	16.8
5	0.900	22.9	0.708	18.0
6	1.000	25.4	0.785	19.9
7	1.125	28.6	0.890	22.6
8	1.250	31.8	1.000	25.4
9	1.375	34.9	1.110	28.2
10	1.562	39.7	1.262	32.1
11	1.812	46.0	1.492	37.9
12	2.125	54.0	1.798	45.7
13	2.437	61.9	2.125	54.0
14	2.875	73.0	2.437	61.9
15	3.625	92.1	3.062	77.8

SIZE SL	"A"		"B"	
	Inch	mm	Inch	Mm
16	4.500	114.3	3.875	98.4
17	5.500	139.7	4.875	123.8
18	6.500	165.1	5.875	149.2

SL BLADES

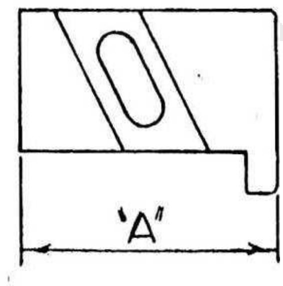


TABLE 24.

SIZE SL	"A"	
	Inch	mm
1	0.692	17.6
2	0.745	18.9
3	0.805	20.4
4	0.865	22.0
5	0.935	23.7
6	1.055	26.8
7	1.175	29.8
8	1.295	32.9
9	1.425	36.2
10	1.665	43.3
11	1.905	48,4
12	2.272	57.7
13	2.642	67.1
14	3.132	79.6
15	3.892	98.9
16	4.805	122.0
17	5.743	145.9
18	6.743	171.3

2.4.2. Dismantling the Reamer – SL Type

The procedure for dismantling the reamer is identical to that for S type reamers and is outlined on page 28.

2.4.3. Assembling the Reamer – SL Type

The procedure for assembling the reamer is identical to that for S type reamers and is outlined starting on page 26.

NOTE: The blade protrusion will face the nose of the reamer with the End Cap flats being correctly orientated to accommodate the protrusions.

2.5. BLADES

The blades are manufactured in two basic forms:

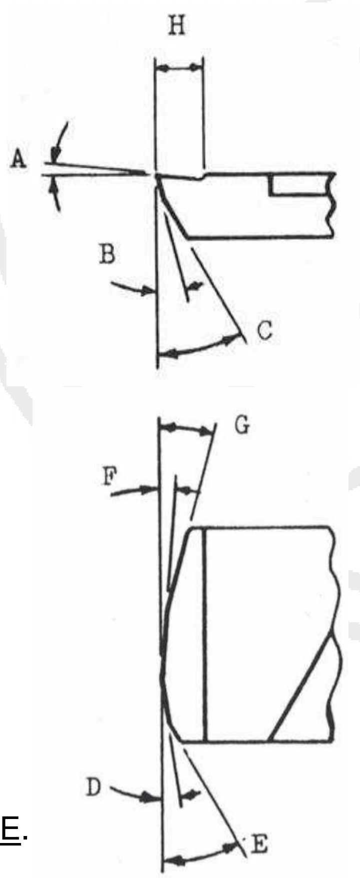
1. Rectangular to suit S and SS type.
2. Rectangular with protrusion ('L' shaped) to suit SL type.

It is standard practice to manufacture all blades to simple geometric forms and these are maintained for all blades in normal production. However, the forms can be modified to suit particular applications, so to avoid confusion, the relevant terminology used is clearly defined as follows:

1. **SS / S Type**

   The terms used to define the form of these blades are contained in illustrated in Table E.

TERMINOLOGY - BLADES



KEY	
SYMBOL	**ANGLE**
A	TOP RAKE
B	PRIMARY FRONT RAKE
C	SECONDARY FRONT RAKE
D	PRIMARY LEAD
E	SECONDARY LEAD
F	PRIMARY CLEARANCE
G	SECONDARY CLEARANCE
H	SHARPENING LAND

TABLE E.

2.5. BLADES

The blades are manufactured in two basic forms:

1. Rectangular to suit S and SS type.
2. Rectangular with protrusion ('L' shaped) to suit SL type.

It is standard practice to manufacture all blades to simple geometric forms and these are maintained for all blades in normal production. However, the forms can be modified to suit particular applications, so to avoid confusion, the relevant terminology used is clearly defined as follows:

1. **SS / S Type**

   The terms used to define the form of these blades are contained in illustrated in Table E.

CONFIGURATION OF STANDARD BLADES							
BLADE		TYPE & SIZE OF REAMER					
ANGLE	MATERIAL	SS1 To SS3	SS4 To SS5	S1 To S14	SL1 To SL14	S15 To S18	SL15 To SL18
Top Rake	HSS TCT	No Top Rake					
Primary Front Rake	HSS TCT	10º	12º	12º	12º	13º	13º
Secondary Front Rake	HSS TCT	No Secondary Front Rake					
Primary Lead	HSS TCT	30º	30º	30º	45º	30º	45º
Secondary Lead	HSS TCT	No Secondary Lead					
Primary Clearance	HSS TCT	0.15º	0.15º	0.15º	0.15º	0.15º	0.15º
Secondary Clearance	HSS TCT	3º 3º	3º 3º	0º 5º	0º 5º	5º 5º	5º 5º
Sharpening Land	HSS TCT	Blades Ground Parallel					
							Table F.

2.5.1. Sharpening of Blades

The Blades should be removed from the reamer in accordance with the laid down procedures.

The Blades can then be sharpened using either a tool and cutter grinding machine or a simple surface grinding machine. Where the Blades require a top rake, other than zero, then the use of an auxiliary tilting table or simple jig is convenient but not essential. If a tilting table is not available, then provision must be made to enable the periphery of the grinding wheel to be angled to produce the required top rake.

The blades should be sharpened in accordance with the following procedure:

1. If an auxiliary tilting table or jig is available, then it should be mounted on the machine table so that the direction of tilt is normal to the direction of machine slide reciprocation.
2. Mount the Blades on the table or in the jig. If a table is being used, then care must be taken to ensure the cutting edges are in line with each other and with the direction of machine tool slide reciprocation.
3. Where an auxiliary tilting table is being used then this should be set to the required top rake.
4. Dress the periphery of the grinding wheel to the following form:
    a) Where an auxiliary tilting table or jag is being used then the grinding wheel periphery will be trimmed parallel to the grinding wheel spindle.
    b) Where top rake is required and there is no means of tilting the blades, then the periphery of the grinding wheel will be trimmed at an angle equal to the top rake and relative to the grinding wheel spindle.
5. Position the grinding wheel in relation to the blades so that as the table reciprocates, a parallel band (sharpening land) is ground across the blades (See Table G). Continue grinding until the cutting edges are restored. Care must be taken to remove this stock at a rate consistent with good grinding practice to prevent burning, which would have a detrimental effect on the cutting edge.

Recommended Width Of Sharpening Land	
SIZE & TYPE OF REAMER	**LAND WIDTH**
SS1 – SS5	0.040" – 0.050" 1.02mm – 1.27mm
S/SL1 – S/SL7	0.050" – 0.075" 1.27mm – 1.90mm
S/SL8 – S/SL14	0.075" – 0.100" 1.90mm – 2.54mm
S/SL15 – S/SL18	0.100" – 0.150" 2.54mm – 3.81mm
	TABLE G

6. Once the cutting edge has been restored the grinding wheel periphery will be dressed and light cuts ("sparking out") used to obtain a good surface finish (N5 - 16 µinch/0.4µm Ra). In the case of Tungsten Carbide Tipped Blades the grinding operation will be followed by a finishing operation using a diamond impregnated grinding wheel.

Examples of reamer blades being sharpened both with and without top rake are shown in Figures 13 & 14 respectively. It is essential that the blades are ground as matched pairs, so that when they are assembled in the reamer body the cutting edges will be radially aligned.

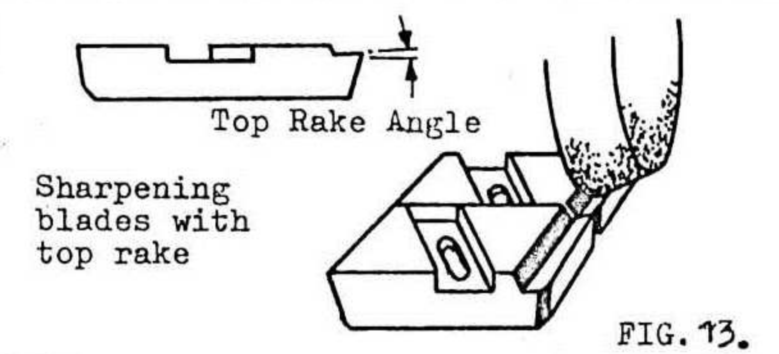


FIG. 13.

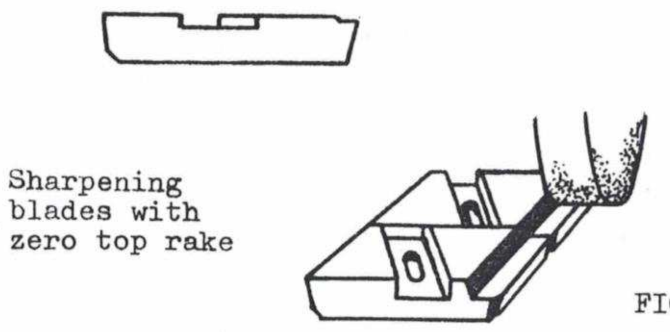


FIG. 14.

Normally the blades should not be sharpened by grinding the front rake. However, on occasions the front rake surface is damaged, and this damage cannot be removed by grinding the top rake without either destroying the blade or at best reducing the effective blade thickness by an excessive amount, so in the interests of economy it may be necessary to remove the damage by grinding the front rake. The blades must once again be ground as a matched pair and care must be taken to reproduce the cutting-edge form identical to that before damage took place. An example of blades being ground on the front rake is illustrated in figure 15.

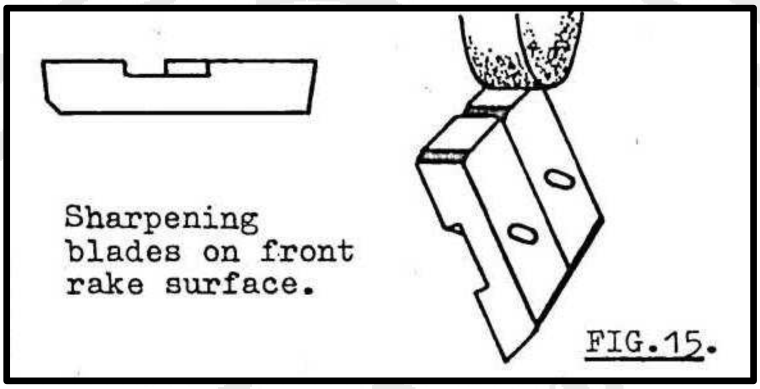


FIG.15.

If the blades are ground with an incorrect form of cutting edge, this can result in them failing to centralise in the component, or the generation of excessive chatter during the reaming operation, the consequence of which may be scrapped or defective work, together with the possibility of irreparable damage to the reamer.

NOTE: The removal of material from the front rake surface will reduce the working range of the reamer.

3.0. GUIDE TO THE USE OF THE REAMER

Due to the many variables encountered when deciding on the operating conditions of the reamer, any recommendation can only be made in general terms. However, following these recommendations, should enable the user to select and use a reamer with confidence that it will result in the production of holes having a quality of dimensional accuracy and surface finish equal to that normally associated with the best obtainable by the reaming process.

3.1. Selecting the Reamer for the job

The choice of reamer is controlled by the size and form of hole to be reamed and can be made with reference to Tables H and I.

REAMER LIMITS			
REAMED HOLE DIA.		**SIZE & TYPE OF REAMER**	
Min.	**Max.**	**Through Hole**	**Stepped or Blind Hole**
0.500” 12.70mm	0.531” 13.49mm	SS1	-
0.531” 13.49mm	0.531” 14.68mm	SS2	-
0.578” 14.68mm	0.625” 15.87mm	SS3	-
0.625” 15.87mm	0.687” 17.46mm	SS4	-
0.687” 17.46mm	0.750” 19.05mm	SS5	-
			TABLE H.

NOTE: Extended blades (shaped) for use in reaming stepped or blind holes are not available for the SS range of reamers.

REAMER LIMITS			
Reamed Hole Diameter		**Size and Type of Reamer**	
Min.	**Max.**	**Through Hole**	**Stepped or Blind Hole**
0.750 19.0	0.812” 20.6mm	S1	SL1
0.812” 20.6mm	0.875” 22.2mm	S2	SL2
0,875” 22.2mm	0. 937” 23.8mm	S3	SL5
0.937” 23.8mm	1.000” 25.4mm	S4	SL4
1.000” 25.4mm	1.125” 28.6mm	S5	SL5
1.125” 28.6mm	1.250” 31.8mm	S6	SL6
1.250” 31.8mm	1.375” 54.9mm	S7	SL7
1.375” 34.9mm	1.500” 38.1mm	S8	SL8
1.500” 38.1mm	1.750” 44.4mm	S9	SL9
1.750” 44.4mm	2.000” 50.8mm	S10	SL10
2.000” 50.8mm	2.375” 60.3mm	S11	SL11
2.375” 60.3mm	2.750” 69.8mm	S12	SL12
2.750” 69.8mm	3.250” 82.5mm	S13	SL13
3.250” 82.5mm	4.000” 101.6mm	S14	SL14
4.0” 101.6mm	5.000” 127.0mm	S15	SL15
5.000” 127.0mm	6.000” 152.4mm	S16	SL16
6.000” 152.4mm	7.000” 177.8mm	S17	SL17
7.000” 177.8mm	8.000” 205.2mm	S18	SL18

TABLE I.

3.2. Selection of Blade Material

The reamer blades are supplied either in solid High Speed Steel (HSS) or with Tungsten Carbide Tips (TCT).

The use of TCT blades does not normally result in faster production through increased speed and feed rates, as these are normally a function of the required surface finish. However, due to the wear resistant qualities of Tungsten Carbide it is possible to ream many more parts per sharpen using the TCT blades. This can result in significant savings in down time caused by 'in shift' tool changes and adjustments. On occasions excessive wear occurs when using HSS blades thus reducing the possible speed and feed rates consistent with maintaining the required surface finish.

In these cases, the use of TCT blades may result in increased production rates, as well as increasing the parts per sharpen ratio. In general, the use of TCT blades does result in significant increase in the parts per sharpen ratio, particularly with Cast Iron and Non-Ferrous materials, but several anomalies have occurred when reaming steels resulting in no increase, or in some cases a reduction, in the number of parts per sharpen ratio.

The choice of blade material will normally be decided on economic grounds, based on tool cost per component, which is usually established by the user.

A list of component materials with the suggested blade materials are listed in Table J.

Component Material	Blade Material
Non Ferrous	TCT
Plastic & Other Non Metallic Materials	TCT
Cast Iron	TCT
Mild or Soft Steels - (Under 280 Brinell)	HSS
Tough Steels - (Over 280 Brinell)	TCT
SUGGESTED BLADE MATERIAL	TABLE J

3.3. Selection of Blade Top Rake Angle

Unless otherwise requested all blades are supplied with zero top rake. However, to improve the cutting action and obtain the desired surface finish, the top rake may require adjusting to suit the particular material being reamed.

A list of component materials with the suggested top rake angles are listed in Table K.

SUGGESTED TOP RAKE ANGLE		
Component Material	**Blade Material**	
	HSS	TCT
Bronze, Brass & Gunmetal	0^{o}	0^{o}
Cast Iron	3^{o}	0^{o}
Tough Steels (Over 280 Brinell)	5^{o}	0^{o}
Mild or Soft Steels (Under 280 Brinell)	7^{o}	3^{o}
Aluminium & Aluminium Alloys	12^{o}	5^{o}
Plastics & Other Non Metallic	15^{o}	7^{o}
		TABLE K

3.4. Selection of Feed Rate & Component Surface Speed

The choice of feed and speed is very difficult to specify, due to the many factors which are involved. Namely:

Component material

Blade material

Condition of Machine Tool

Importance of surface finish obtained against length of cycle time.

Coolant

It must be appreciated that in general terms, the higher the grade of surface finish obtained, the longer will be the cycle time, so it is important to choose feeds and speeds to keep the cycle times to a minimum, consistent with obtaining the necessary grade of surface finish.

A list of component materials with recommended feeds and speeds are listed in Table L.

RECOMMENDED FEED RATES & COMPONENT SURFACE SPEEDS		
Component Material	**Surface Speed**	**Feed Rate**
Steel	20-50ft/min 6-15m/min	0.010 - 0.040inch/rev 0.25 - 1.00mm/rev
Cast Iron	20-40ft/min 6-12m/min	0.020 - 0.040inch/rev 0.51 - 1.00mm/rev
Bronze, Brass & Gunmetal	20-60ft/min 6-18m/min	0.015 - 0.040inch/rev 0.38 - 1.00mm/rev
Aluminium & Aluminium Alloys	30-90ft/min 9-27m/min	0.015 - 0.040inch/rev 0.38 - 1.00mm/rev
Plastics & Other Non-Metallic Materials	30-90ft/min 9-27m/min	0.015 - 0.040inch/rev 0.38 - 1.00mm/rev
		Table L

In the first instance it is advisable to select a surface speed and feed rate equal to the minimum recommended for a particular material. Then, depending on the quality of the hole produced, the speeds and feeds can be progressively adjusted to obtain the desired surface finish consistent with a minimum cycle time. It can be well worth experimenting to obtain the correct balance between surface speed and feed rate to obtain optimum performance from the reamer, (relative to particular applications and operating conditions).

3.5. Selection of Coolant

The choice of coolant used may be influenced by the type of machine tool on which the reamer is to be used or the coolant most readily available. Where possible a copious supply of coolant should be provided, to assist in swarf removal from the reaming area. A list of component materials together with suggested coolants are listed in Table M.

SUGGESTED COOLANTS	
Component Material	**Coolant**
Steel	Soluble Oil or Straight Cutting Oil
Cast Iron	Soluble Oil or Dry
Bronze, Brass & Gunmetal	Soluble Oil or Dry
Aluminium & Aluminium Alloys	Paraffin or Dry
Plastics & Other Non-Metallic Materials	Soluble Oil or Dry
	Table M

For certain steels and operating conditions, some advantage may be gained by coating the hole with a straight cutting oil prior to reaming. In the case of aluminium, the hole may be coated with paraffin. Oil and paraffin would normally be applied with a suitable brush. In the case of non-metallic materials, car must be taken to ensure that any coolant used does not adversely affect the material.

3.6. Preparation of the Hole to be reamed

If the reamer is to reach its full potential, then it is essential that the hole is carefully prepared prior to the reaming operation. After pre-drilling, the hole should be semi-finished with a boring operation. The entering face should be machined and where possible a small chamfer provided to assist the blades to centralise as the reamer enters the hole.

It is essential that the correct amount of stock is left in the hole for the reaming operation, as too much or too little stock will result in a tendency for the blade to be forced in and out of cut, with a consequent deterioration in surface finish.

The recommended amounts for stock to be left in the hole for removal by the reamer are contained in Table N together with the relevant size and type of reamer.

Note: The quality of the final reamed hole will reflect the quality of the bored hole.

RECOMMENDED REAMING STOCK	
Size & Type of Reamer	**Reaming Stock (on diameter)**
SS1 - SS5	0.003" - 0.005" / 0.07mm - 0.12mm
S1 - S14 & SL1 - SL14	0.005" - 0.007" / 0.12 - 0.20mm
S15 - S18 & SL15 - SL18	0.007" - 0.010" / 0.20mm - 0.25mm
	TABLE N.

a) **<u>Blade setting dimension requires reducing.</u>**

Rotate the Adjusting Lock Ring clockwise (looking from the shank end) to free the Adjusting Dial Ring.

Complimentary rotate the two Adjusting Rings in a clockwise direction until the Adjusting Dial Ring has moved through the number of divisions necessary to make the required adjustment.

Rotate the Adjusting Lock Ring anticlockwise until the two rings are firmly locked together. Verify the Blade setting dimension using the micrometer.

After the initial setting has been made or where only small adjustments are required, then it should not be necessary to further verify blade settings with the micrometer. The graduations on the Adjusting Dial Ring can be used with complete confidence to make small adjustments. The graduations give direct readings of 0.001" (0.0254mm) per division and these can be interpolated, enabling extremely fine adjustments to be made.

It is essential to remember that in making blade setting adjustments the Adjusting Dial Ring will be rotated through the necessary angular distance in the following directions:

a) <u>CLOCKWISE</u> to <u>REDUCE</u> the setting dimension.
b) <u>ANTI-CLOCKWISE</u> to <u>INCREASE</u> the setting dimension.

<u>NOTE:</u> The directions of rotation are defined looking from the <u>SHANK END</u>.

<u>3.8. Mounting the Reamer in the Machine Tool</u>

When mounting the reamer, care must be taken to ensure the reamer shank and the tool holder are clean. The reamer must be mounted rigidly because the reamer blades are designed to centralise as they enter the hole, due to the radial component of the cutting force.

The reamer should not be mounted in a floating holder.

The ability of the blades to float and centralise minimises the effects of misalignments in the machine tool.

If the misalignments of the machine tool are known, then the reamer can be positioned to its best advantage.

e.g. When using the reamer in a capstan lathe with known alignment errors between the headstock and tool holder, then the reamer should be set with the blade cutting edges in the plane of maximum misalignment.

3.9. The Reamer in Operation

Whilst the reamer is an efficient cutting tool, easy to use and robust in operation, it is essential to understand the principals involved if optimum performance is to be attained. From a component quality point of view the performance of the reamer may be judged on two main aspects.

1. **Dimensional Accuracy**

   If dimensionally accurate components are to be produced, then it is essential that:

   - the pre-reamed hole must be correctly prepared.
   - the blades must be set to the correct size.
   - the blade adjusting mechanism must be securely locked to prevent size change under pressure.
   - any wear taking place at the blade cutting edge must be compensated for by adjustment to the blade setting.
   - the component must not be distorted by chucking or tool pressures.
   - the cut must not be allowed to run hot.
   - the swarf must be cleared from the reaming area to prevent 'build up' at the cutting edge.
   - the blades must float freely and centralise an entry to the hole.

   The blades are prevented from floating and centralising because:

   - misalignment in the machine tool is in excess of the blade float.
   - burrs are formed on either the blades or in the blade slots.
   - dirt or swarf enters the blade assembly through the slots.
   - insufficient lead angle on the blades together with a large top angle can cause one blade to catch and hold in the cut, thus preventing centralisation of the blade.

These hostile conditions must be corrected to allow the blade float to be effective.

2. **Surface Finish**

   The quality of surface finish produced when reaming is dependent on several factors:

   a) the cutting characteristics of the component material.

   b) surface speed.

   c) feed rate.

   d) the general condition of the machine tool.

e) the stability of the component and reamer mounting.

f) the blade cutting edge geometry.

When reaming soft and tough materials there is a tendency for the swarf to build up on the cutting edge causing the material to tear and this results in a serious deterioration in surface finish. This tendency can be reduced by increasing the top rake and surface speed and reducing the feed rate. Increasing the top rake can have an undesirable side effect, in that there is a greater tendency for one blade to catch and 'hold in' cut as the reamer enters the hole thus preventing the blades centralising. When reaming hard materials there is less tendency for the swarf to build up on the cutting edge. Consequently, a relative lower surface speed and less top rake is required for a comparative surface finish. The reduction in top rake and surface speed can normally be accompanied by an increase in feed rate.

If there is a lack of stability in the machine tool or in the component and reamer mounting, then vibrations will be induced causing chatter with consequent deterioration in surface finish. The geometry of the blade cutting edge can have a marked effect on the quality of hole produced and:

- modification to the primary and secondary lead angles can assist in centralising the blades as the reamer enters the hole.
- light stoning of the intersection between the lead and clearance angles to form a radius will help to remove tool marks.
- increasing the primary and secondary clearance angles can remove problems caused by the blades 'heeling' and causing chatter.

In common with other cutting tools the life of the blade cutting edges is dependent on the abrasive qualities of the component material and the heat generated at the cutting edge.

The heat generated at the cutting edge is a function of the feed rate and surface speed, and in general, low surface speeds with high feed rates will give longer tool life than high surface speeds and low feed rates, consistent with maintaining the same level of productivity.

The use of large top angles will render the blade more susceptible to premature breakdown of the cutting edge.

In conclusion it is obvious that the correct balance between surface speed, feed rate, blade geometry and stock removal is an important factor in achieving full potential with the reamer. The choice of coolant can have a significant effect on the quality of hole produced by cooling and lubricating the cutting edge, and where a copious supply is available, removing swarf from the reaming area.

3.9.1. Identification and Correction of Reaming Faults

On occasions, faults may occur when using the Reamer. In order to identify and correct these faults, a table has been compiled which suggests possible corrective action (See Table O).

REAMING - IDENTIFICATION OF POSSIBLE FAULTS WITH SUGGESTED CORRECTIVE ACTION		
Symptom	**Possible Cause**	**Suggested Corrective Action**
Oversize Hole	Incorrect setting of blades (too large).	Adjust blade setting.
	Pre-reamed hole too large.	Ensure correct amount of stock is left in the pre-reamed hole.
	Blades do not float and centralise correctly because:	
	• of burrs on the blades or in the slots.	Clean the blades, slots and stone burrs to ensure blades float freely in the slots.
	• of dirt or swarf in the slots and blade assembly.	
	• the top rake angle is too acute resulting in one blade catching and holding in cut as the reamer enters the hole.	Reduce the top rake angle.
	• the lead angle is too small or of incorrect form.	Increase or modify the form of the primary and secondary lead angles.
	• the machine tool alignment errors are not fully compensated.	Check and correct (if possible) the concentricity and alignment of the reamer relative to head stock. Align the blade cutting edges in the plane of maximum alignment error.
	• of a build-up of swarf on one blade forcing the blade assembly to one side.	a) Where possible ensure a copious supply of coolant to remove the swarf from the reaming area. b) Where a soluble oil is used provide a less diluted solution. c) Where possible change the type of coolant. d) Increase top rake angle. e) Progressively increase the surface speed and decrease the feed rate.

TABLE O

REAMING - IDENTIFICATION OF POSSIBLE FAULTS WITH SUGGESTED CORRECTIVE ACTION		
Symptom	**Possible Cause**	**Suggested Corrective Action**
Undersize Hole	Incorrect setting of blades (too small).	Adjust blade setting.
	Blade assembly has compressed under pressure.	Adjust blade setting and ensure the adjusting mechanism is firmly locked.
	The cut has run hot, and the hole closed in on cooling.	Provide better cooling of the component and reamer.
Hole not round	The pre-reamed hole not round.	Check too land set up used for pre-reaming operation and correct as required.
	Component distorted.	Reduce chucking pressure or modify work holding fixture (Note: chucking pressure must be sufficient to hold the component securely).
Hole "Bell Mouthed"	Blades do not float and centralise correctly because:	
	• the top rake angle is too acute, resulting in one blade catching and momentarily holding in a cut as the reamer enters the hole.	Reduce top rake angle.
	• the lead angle is too small or of incorrect form.	Increase or modify the form of the primary and secondary lead angles.
Inadequate surface finish	Surface speed to high.	Progressively reduce the surface speed.
	Feed rate too high.	Progressively reduce the feed rate.
	Swarf "Build Up" at blade cutting edge.	a) Where possible ensure a more copious supply of coolant to remove the swarf from the remaining area. b) Where a soluble oil is used provide a less diluted solution. c) Where possible change the type of coolant. d) Increase the top rake angle. e) Progressively increase the surface. speed and decrease the feed rate.

TABLE O

REAMING - IDENTIFICATION OF POSSIBLE FAULTS WITH SUGGESTED CORRECTIVE ACTION

Symptom	Possible Cause	Suggested Corrective Action
Feed marks in the hole	Intersection of lead and clearance angles too abrupt.	Remove the sharp corner by hand, using a fine grade carborundum stone. Car must be taken to ensure the blades are kept in a matching pair.
Chatter marks in the hole	Component mounting not stable.	Mount component more rigidly.
	Reamer mounting not stable.	a) Ensure reamer shank and holder are clean. b) Mount reamer more rigidly.
	Blades are “Heeling”.	a) Ensure primary clearance angle is correct (0.15deg) b) Ensure blades have a secondary clearance angle of between 3º and 5º and 1/3 of the blade width.
	Spindle overhang too large.	Reduce spindle overhang to a necessary minimum.
	Machine Tool spindle is running at the critical speed.	Increase or reduce the spindle speed.

TABLE O

DETAILS OF END CAP SCREWS

Size & Type of Reamer	Specifications - “End Cap” Screws	
	Pre-Change	Post Change
SS1 - SS5	12 BA x 0.19” (4.83mm) long All are cheese head with screwdriver slot.	
S1 - S18	All are socket head cap screws apart from those for the S1, S15, S16, S17 & S18.	All are standard socket head cap screws.
S1	9 BA x 0.23” (5.84mm) long	8 BA x 0.31” (7.87mm) long
S2 - S5	8 BA x 0.28” (7.11mm) long	8 BA x 0.31” (7.87mm) long
S6 - S7	7 BA x 0.30” (7.62mm) long	6 BA x 0.38” (9.65mm) long
S8 - S9	6 BA x 0.38” (9.65mm) long	6 BA x 0.38” (9.65mm) long
S10	4 BA x 0.38” (9.65mm) long	4 BA x 0.38” (9.65mm) long
S11 - S13	2 BA x 0.38” (9.65mm) long	2 BA x 0.38” (9.65mm) long
S14	¼” BSF x 0.56” (14.22mm) long	¼” BSF x 0.62” (15.75mm) long
S15 - S18	5/16” BSW x 0.75” (19.05mm) long	5/16 BSW x 0.62” (15.75mm) long

Lengths are measured under head.

All “pre-change” screws for the S range are non-standard.
S2 - S5 and S7 - S14 reamers - Screws to the pre-change specification may be used in the equivalent post change reamer.
Screws to the post change specification may be used in the equivalent pre-change reamer.
The screws used for each reamer in the SL range are identical to those used for the equivalent reamer in the S range.

TABLE P.