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TOOLS AND TOOL MAINTENANCE[1/]

by

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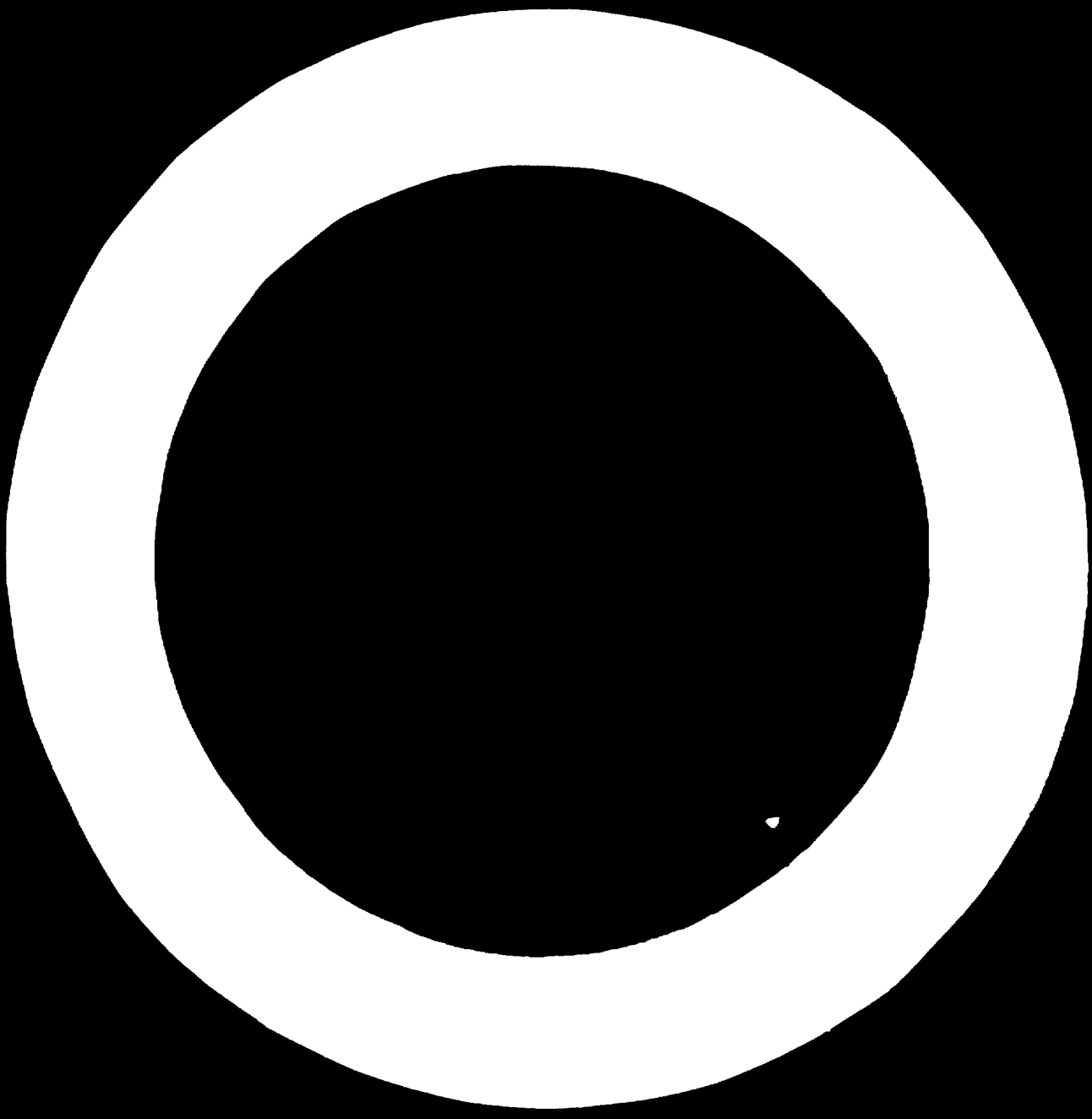


IMPORTANCE OF TOOL MAINTENANCE

Proper tool maintenance is important for, among others, the following reasons:

The finish to a machined surface is rough when worked with a dull blade or knife due to its scraping-like way of chipping. This also results in harmful vibrating of the spindle and cutter block. Further, a dull tool may cut only the soft part of the wood neatly; this is typical of softwood species (e.g. pine, which has a considerable hardness difference between early wood and late wood). When working against the grain direction, a dull tool has a tendency to tear the fibres of the wood, thus producing a bad surface quality. See Figure 1.

High manufacturing accuracy is of prime importance for furniture parts, particularly in joints. When the pieces of the joint fit together exactly, gluing gives the best possible results. See Figure 2. Also, smooth and even machining finish in straight and curved profiles saves time consuming sanding afterwards. Only light sanding is necessary and, above all, the dimensions and the shape of the furniture will be exactly as designed. All this is possible only if well maintained and well sharpened tools are used.

Danger of accidents is diminished when well maintained tools are used. For example, a surface planer with dull knives makes the workpiece vibrate so that it drops or may cause the hand to slip into the rotating cutter. See Figure 3. Also, a dull band saw blade which is not in good condition can easily get stuck in the workpiece, causing the blade to break and resulting in obvious personal hazard.

Energy consumption increases when using dull tools and the worker must push the workpiece harder against the vibrating cutter block and becomes tired. See Figure 4. For example, in edging a dull circular saw blade gets stuck in the sawing groove and power consumption increases so much that the fuses blow up or the safety relay is released.

Tool life depends on the hardness of the workpiece and of the tool material. The sharpening should always be done before tools become too dull in order to effectively eliminate chipping. When grinding very dull tools, a good deal of tool material must be removed. In particular, expensive tungsten carbide tipped tools should be sharpened when they still work satisfactorily. Using tools too long in a dull condition shortens tool life and increases grinding wheel wear. See Figure 5.

Correct intervals between sharpening are important for the reason mentioned above. It saves tool material as well as the time of a special grinding machine. Usually it is better to sharpen the tools too often than too seldom.

Tools which are ready for use must be properly stored so that each type is in its own box or stand. Special tools, such as cutters and carbide tipped tools must be stored in separate boxes. Proper transportation boxes must always be used for moving tools from one place to another.

II THE MOST COMMON TOOLS USED IN THE FURNITURE INDUSTRY

Since no known material meets all the requirements of a good woodworking tool, the material must often be chosen according to the workpiece (wood species, plywood, particle board or wood and plastic laminates). In serial work high speed steel tools are frequently used. When machining very hard, tool wearing wood species, e.g. teak, as well as wood structures containing several glue joints, only tools with carbide tips can be used. Inexpensive carbon steel tools are suitable only for machining softwoods.

Circular saw blades are chosen according to the material being worked and the working method, i.e. whether it is edging or cross cutting, etc. Softwoods are cut best with a wide pitch circular saw blade. See Figure 6. Thin material is cut with a close pitch blade. See Figure 7.

In a machine with a manual feed (e.g. vertical spindle moulder or circular saw for trimming purposes) a blade equipped with a built-in shock absorber and the tooth shaped so as to limit chip thickness is the most suitable. See Figure 8.

When split-sawing very expensive wood, a circular saw blade with conical construction must be used. It can be used in mechanical feed only, and a splitting knife must always be used in connection with it.

Band saw blades are chosen according to the diameter of the band saw wheels, the blade thickness being one thousandth or less of the diameter of the wheel. See Figure 9.

In the furniture industry, the blade widths are chosen depending on the purpose. In straight sawing the blade can be as wide as the structure of the band saw allows. When sawing curved pieces narrower blades should be used, e.g. 15, 12, 8 or 6 mm. Band saw blades with strong setting can be used to saw smaller curves than the width of the blade used implies. Sawing is slower in this case.

When sawing hard woods, the material of the blade used must be hard and tough steel alloy, which is expensive.

Surface and thickness planer knives must be of very high quality high speed steel alloy. They are fairly wear-resistant even when cutting very hard woods. Depending on the structure of the circular cutter-block, the knives are 3 or 4 mm thick. See Figure 10. The widths are standardized 35 and 40 mm. The lengths range from 40 mm up to 1050 mm.

Today the carbide tipped knives for surface and thickness planers are still very expensive to purchase and their sharpening and maintenance is time-consuming and laborious. The fact that they break easily has so far also restricted their use.

Tools used in four-side moulders are chosen according to their use and purchase price. The tools used in temporary machining and small series are always equipped with detachable knives made of high speed steel alloy. A square cutter-block is the most common type. See Figures 10 and 11.

The purchase price of solid (one piece) moulding cutters is high and they must be purchased only after careful consideration and should be maintained well. See Figure 11. There is no need to buy a separate special cutter for profiles of some shapes because they can be obtained using a succession of several cutters.

Borers and mortisers are necessary in making furniture joints. The popular dowel joint is made with a spiral borer. See Figure 12. A good borer is made of high speed steel alloy and is suitable for machining hard woods as well.

A slot borer is actually a router, because it can be fed both in axial and radial directions. See Figure 12. A hole with an even bottom and smooth walls can be made with a knot hole borer. A knot hole borer is necessary also when boring holes for plugging. When machining hardwoods, an oscillating mortising chisel can also be used, which gives a smooth and even finish. A hollow chisel can be used only when machining soft species of wood. See Figure 13.

Routing cutters have small diameters. The cutting edge and the shaft are of high speed steel alloy, but also carbide tipped tools are manufactured. A routing cutter can be straight or curved and equipped with 1, 2 or 3 cutting edges. There are also dovetail routers with adjustable knives. See Figure 13.

Other types of tools in furniture manufacture are necessary in special cases. Dowels are made with a dowel cutter which comes in various diameters according to the joint. See Figure 14. Lathe knives comprise another group also used in furniture manufacture.

III THE MOST IMPORTANT SHARPENING MACHINES AND EQUIPMENT

Simple but versatile standard machines are best suited to the conditions in the developing countries. These machines are small in capacity and, although versatile, the set-up is quite time consuming due to simple construction. When changing from one type of tool to another, the worker must be very careful; otherwise mistakes can easily be made - for example faulty grinding, which may cause severe damage to the tool.

These inexpensive machines of light construction are not suitable for carbide tipped tools. The best way to grind them is to set up a grinding centre in which tools of this type in the whole town or larger area can be sharpened and maintained using special equipment.

A. Choice of Grinding Wheel for Various Purposes

A different grinding wheel must be used for each profile. See Figure 15. The grinding wheel must be cool-working and the bond must be as soft as possible. This increases the costs of the grinding wheel, but, on the other hand, the tool costs decrease.

For grinding high speed steel alloy, an aluminium oxide Al_2O_3 grinding wheel is used.

Pre-grinding is done with grinding wheel number 40-60; fine grinding with wheel number 100-150.

Grinding in two stages results in a smoother finish and a sharper tool. A single grinding can be successful if grinding wheel number 80 and small depth of cut is used. Wet grinding must be used whenever possible.

When grinding a dull and worn carbide tipped tool, three grindings are needed: first pre-grinding with silicon carbide SiC wheel, then grinding with diamond impregnated wheel number 100-150 and lastly fine grinding with diamond impregnated wheel number 220-400. It is important to check that the grinding wheel is not broken before being mounted to the machine and also that the cover is in its proper place. See Figure 15.

B. Common Faults in Grinding

The most common fault in grinding is that the cutting edge burns as a result of too fast single grinding. This is particularly the case in dry grinding. Band saw blades are a good example of this. When the edge of the blade becomes too hot, it breaks easily. See Figure 16. When trying to obtain a very sharp edge the sharpening angle easily becomes too small and the edge breaks. Level grinding (Figure 16A) does not make the grinding angle too small. Wet grinding is the best.

Sharpening angles recommended for different tool materials are:

Carbon steel	-	35°)	for working soft wood
Steel alloy	-	37°)	
High speed steel alloy	-	39°	
Stellite	-	42°	
Tungsten carbide K 40	-	45°	
Tungsten carbide K 30	-	55°	
Tungsten carbide K 20	-	60°	

It often occurs when grinding profile cutters that the knife pairs do not have the same form. This may result even in different weights as well as vibration due to centrifugal force. Often only one of the knives cuts the correct profile. In that case, the feed rate of the workpiece must be lower or else the finish will be uneven.

When grinding solid cutters a pitch controller must always be used to ensure that the pitch remains the same. See Figure 17. In manual grinding the pitch changes easily, resulting in only one edge cutting and vibrations in the spindle. In sharpening moulder cutters, borers and mortising tools too fast grinding damages the whole tool.

Figure 1

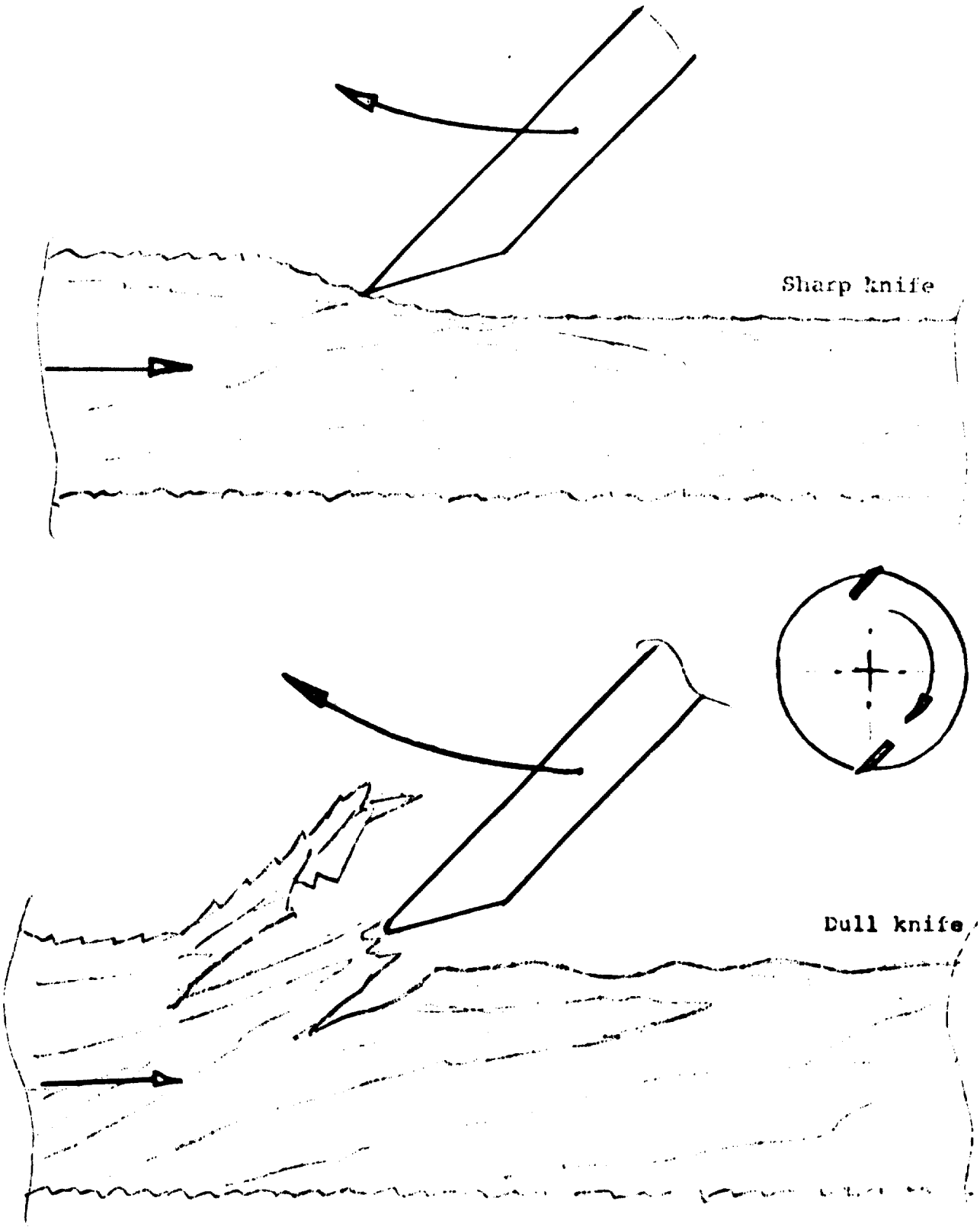
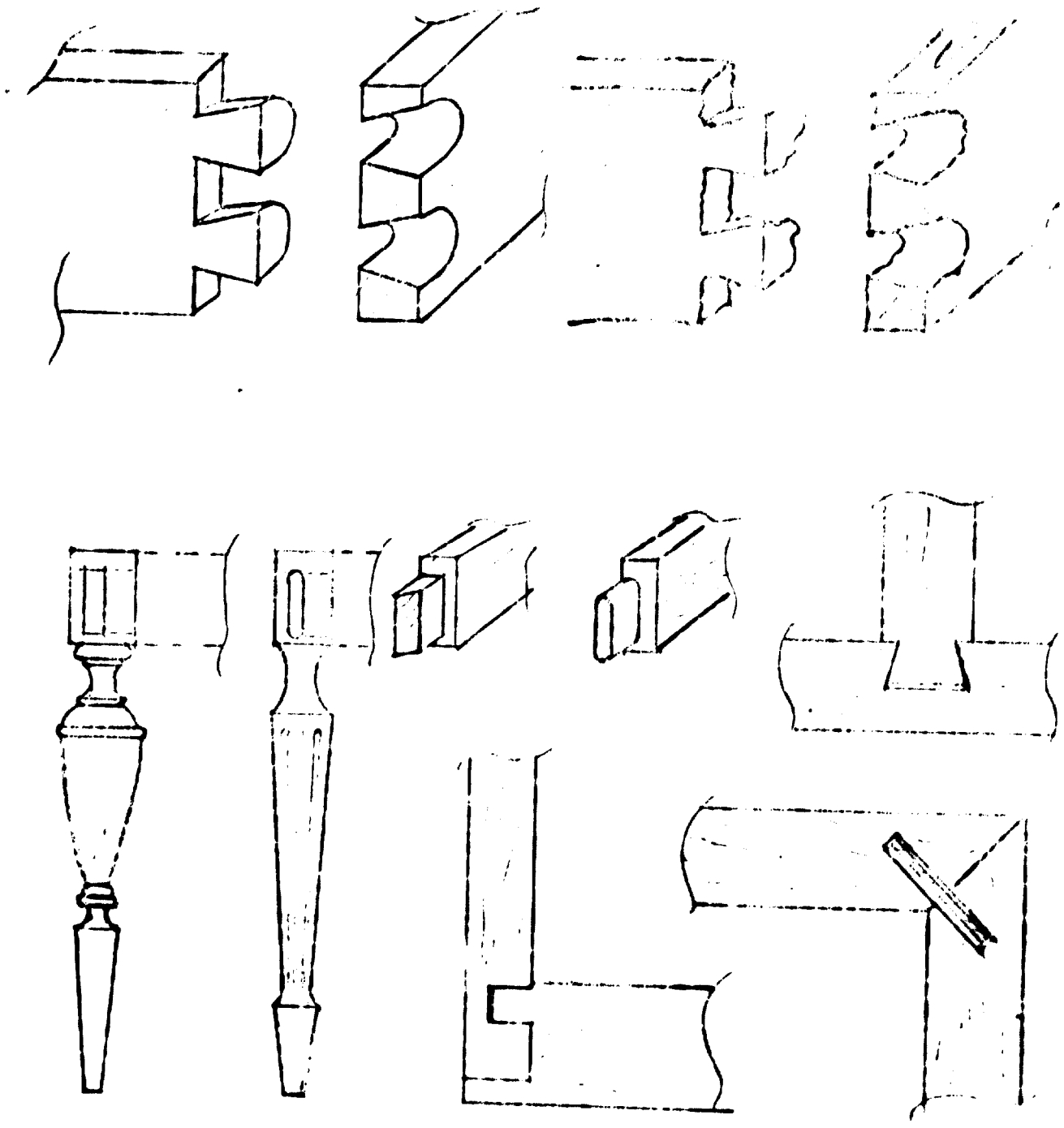


Figure 2

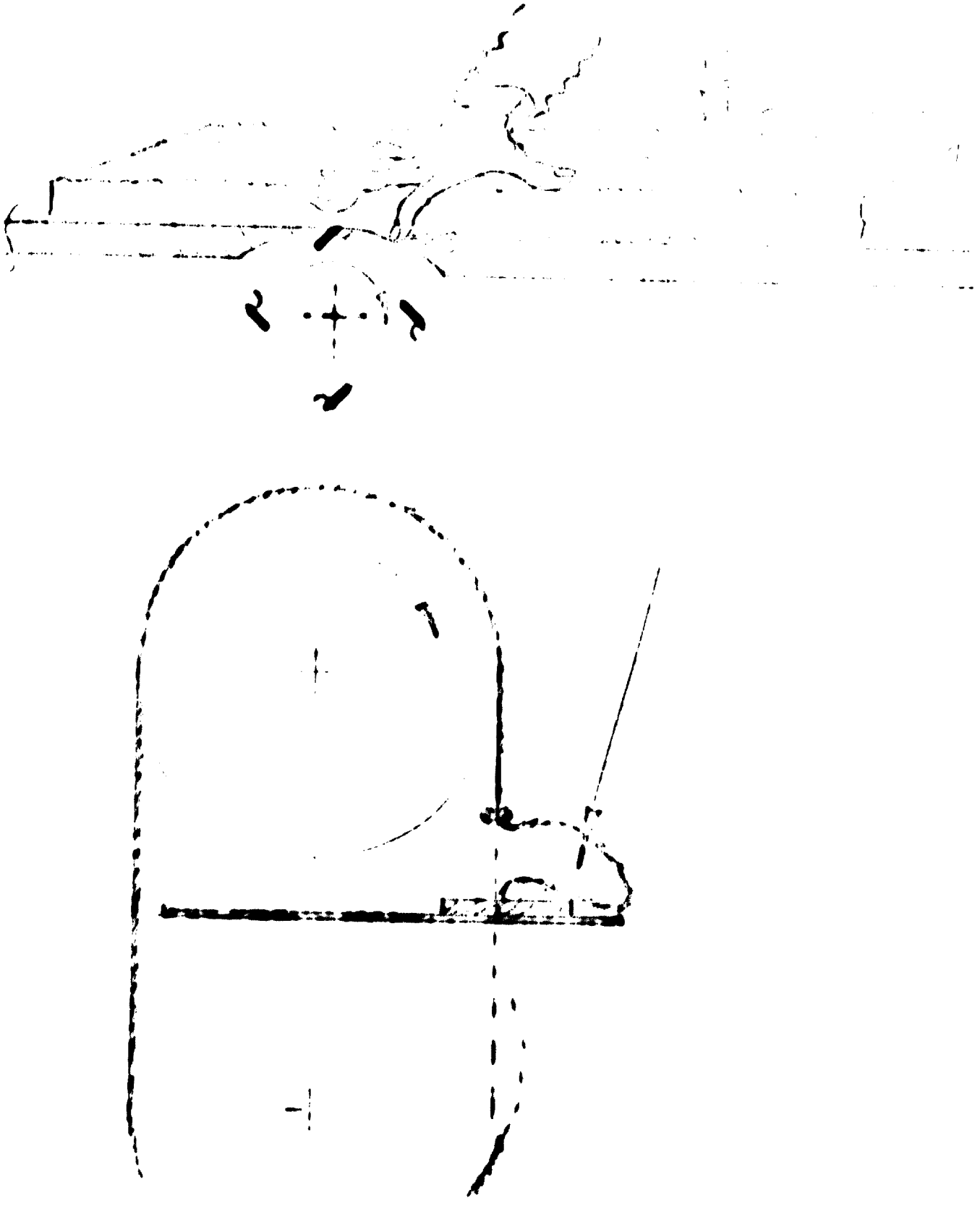
Machined with sharp tool

Machined with dull tool



Good results are achieved only with sharp tool

Figure 3 Dull blade cause statistics

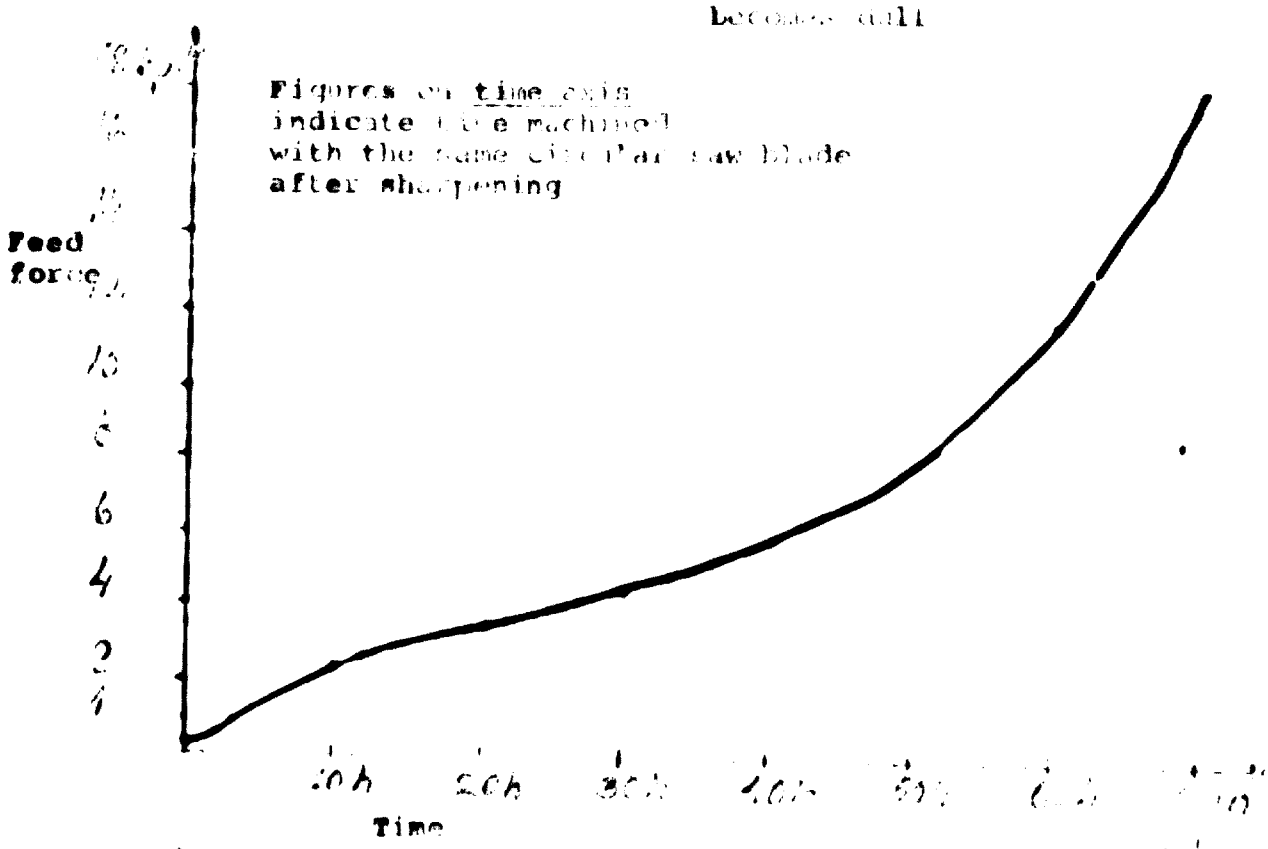


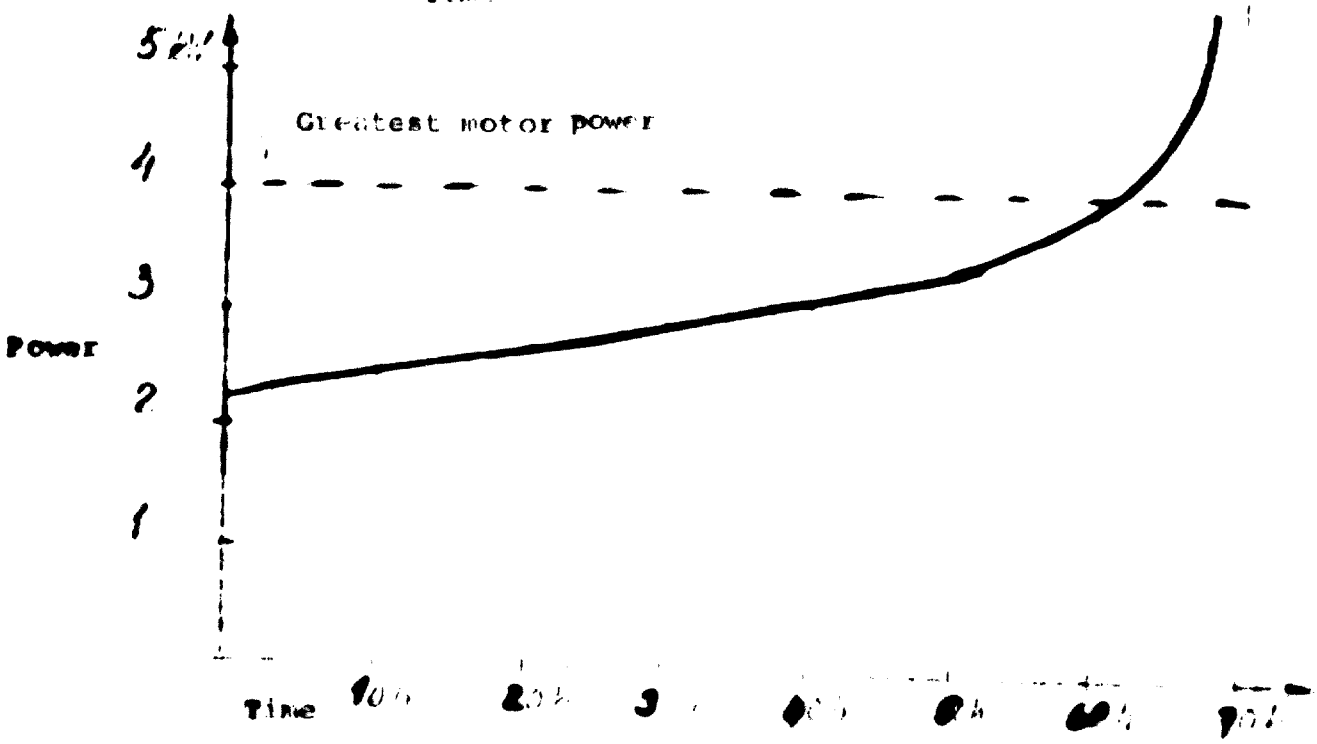
Dull band saw blade gets stuck and breaks

Figure 4

The worker's feed force increases when the blade becomes dull

Figures on time axis indicate time machined with the same circular saw blade after sharpening

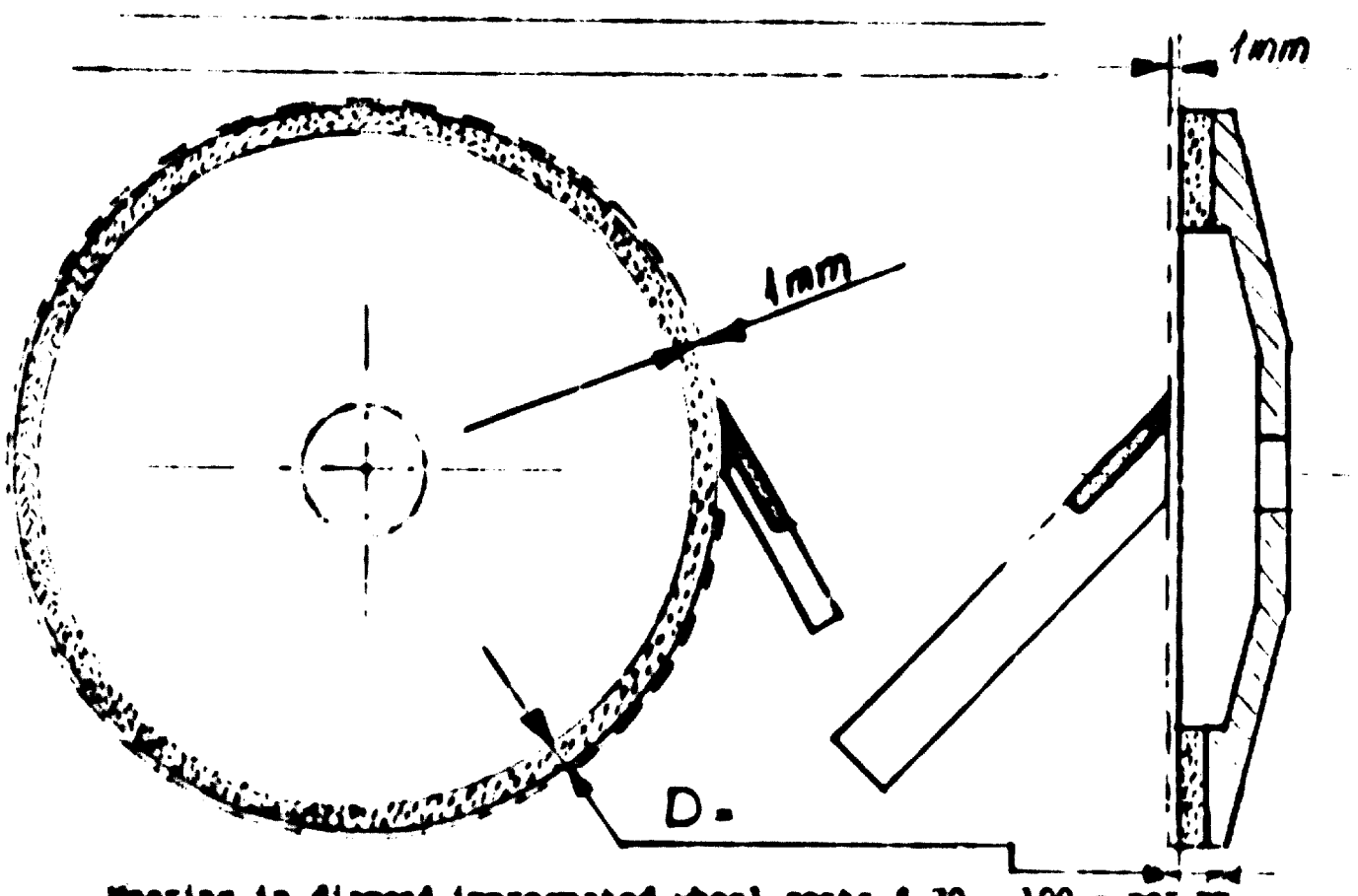




Need for power increases when the circular saw blade becomes dull. When the blade becomes hot it gets stuck and burns the fibres.

Figure 5

Burnt and broken tool blade which has not been sharpened in due time.

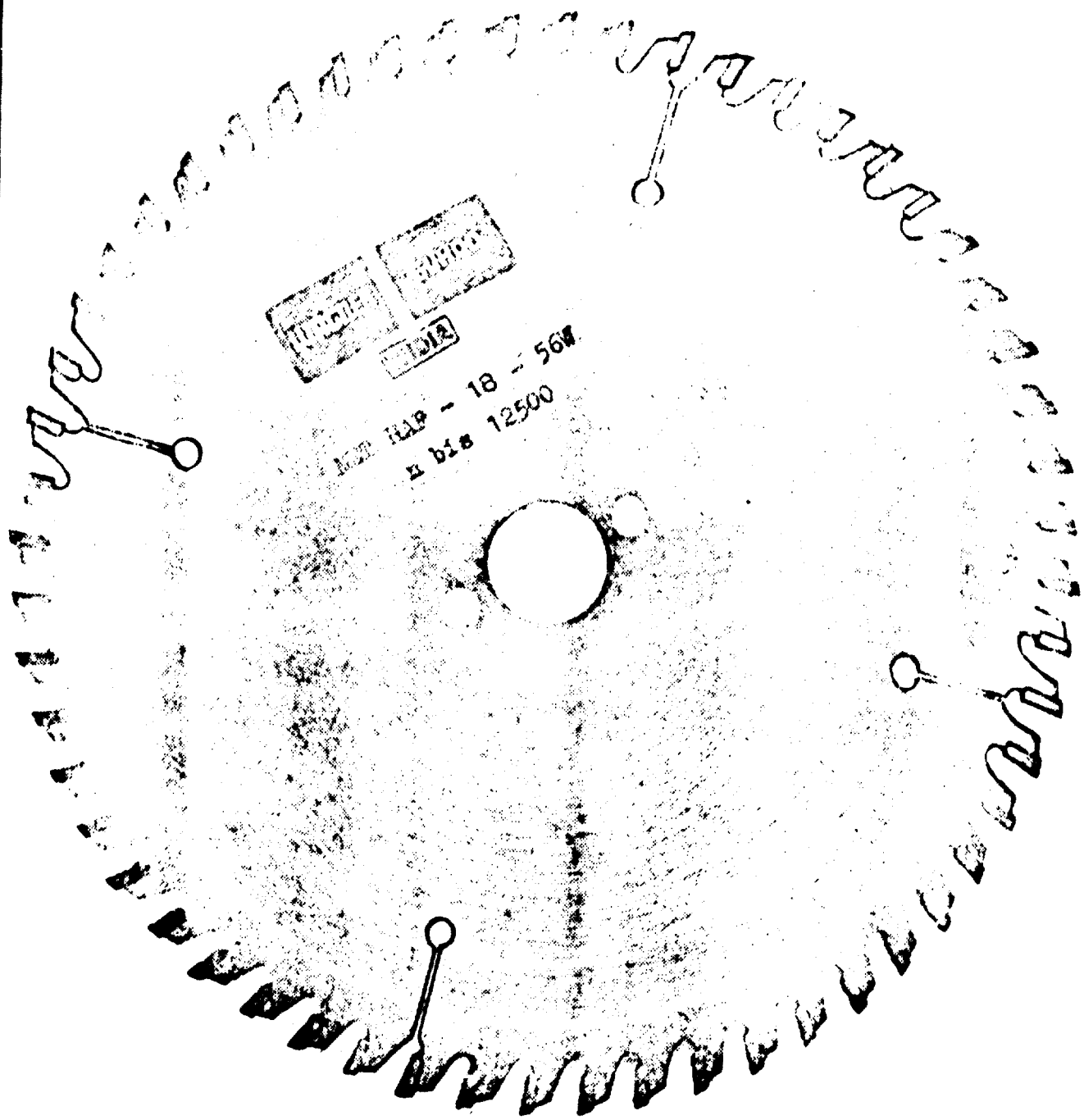


Wearing in diamond impregnated wheel costs $ 70...100,- per mm. Width of diamond part of the wheel decides the price. D = layer of diamond impregnation.

Figure 6

For working softwoods

Figure 7



For working thin material

Figure 8

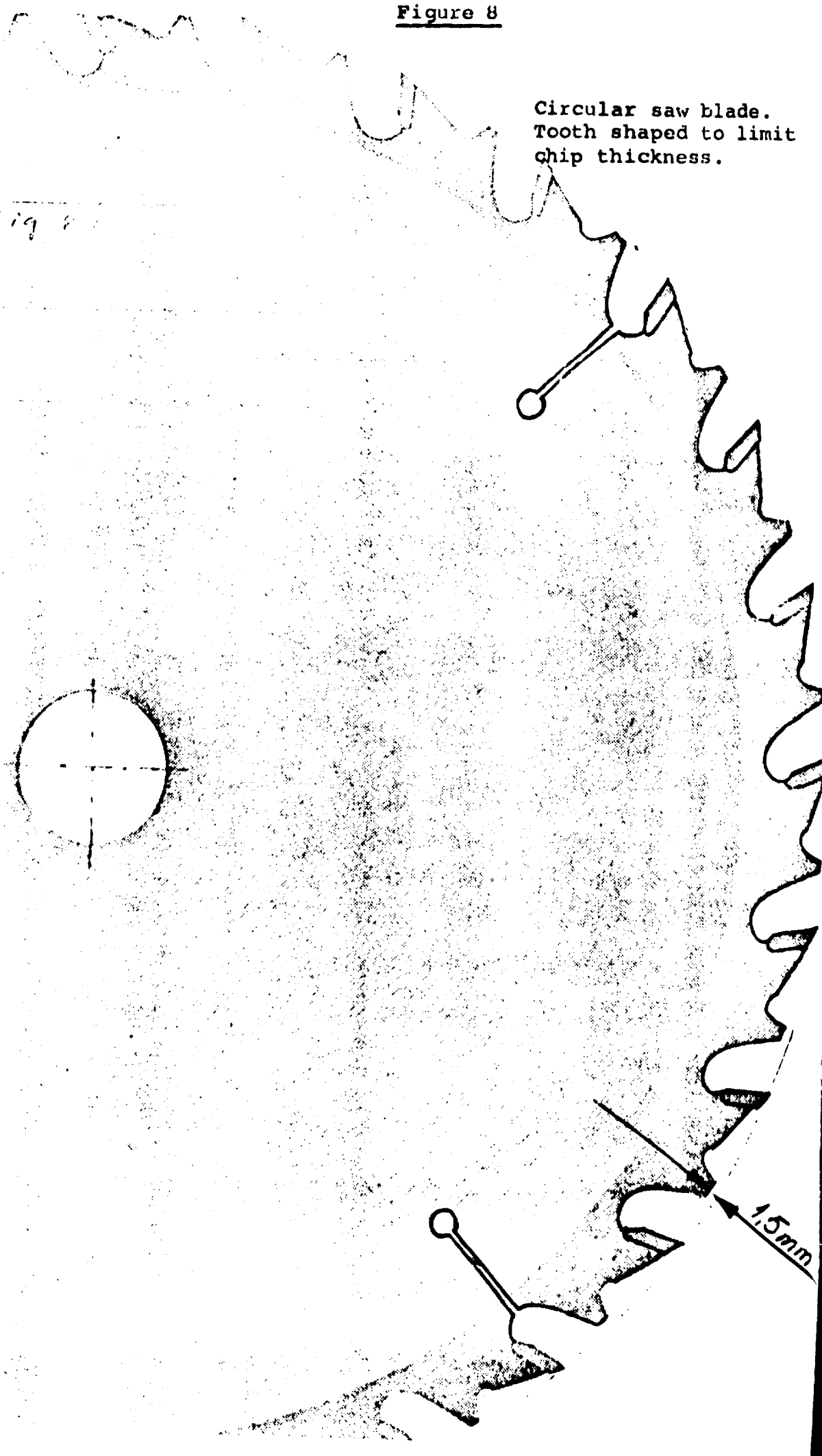
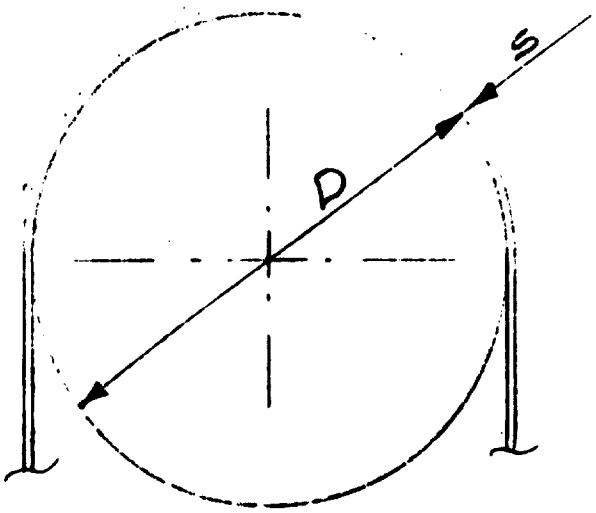
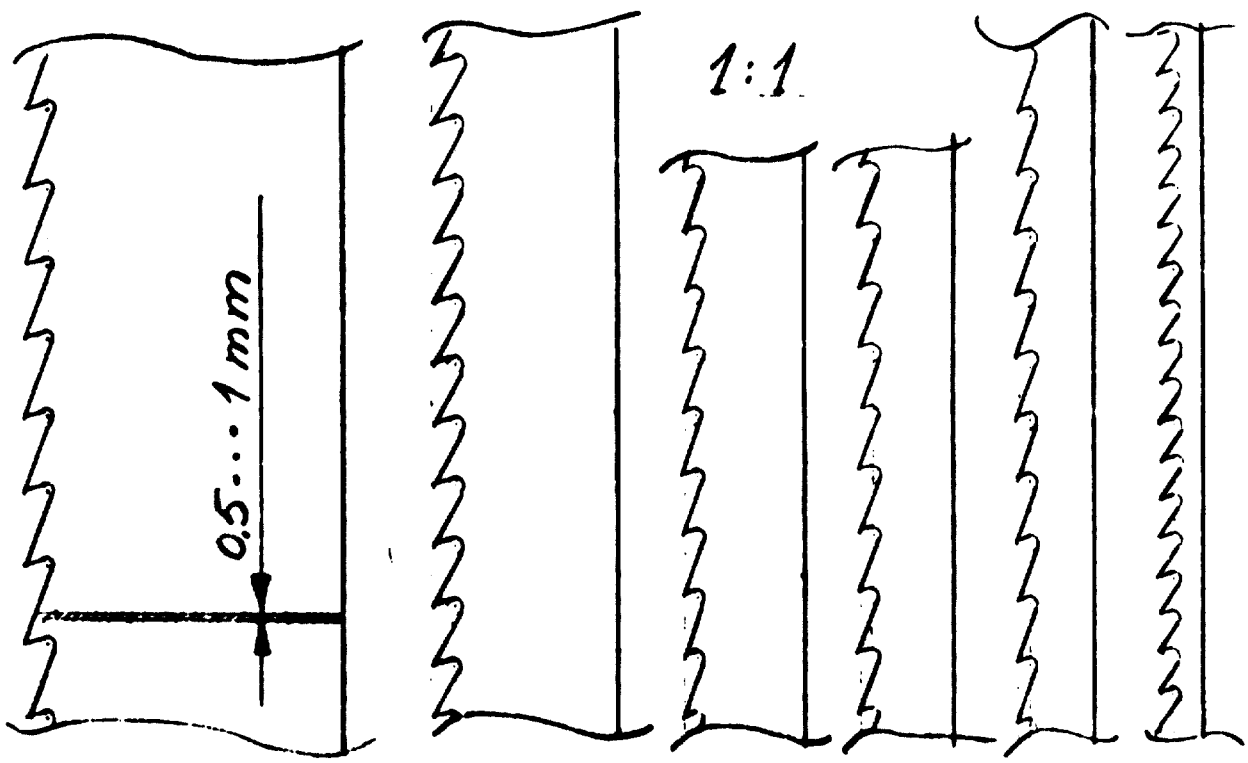

Circular saw blade.
Tooth shaped to limit
chip thickness.
1,5mm

Figure 9



Thinner blade recommended because of bending of the blade. Thicknesses in band saw blades 0.5...1 mm

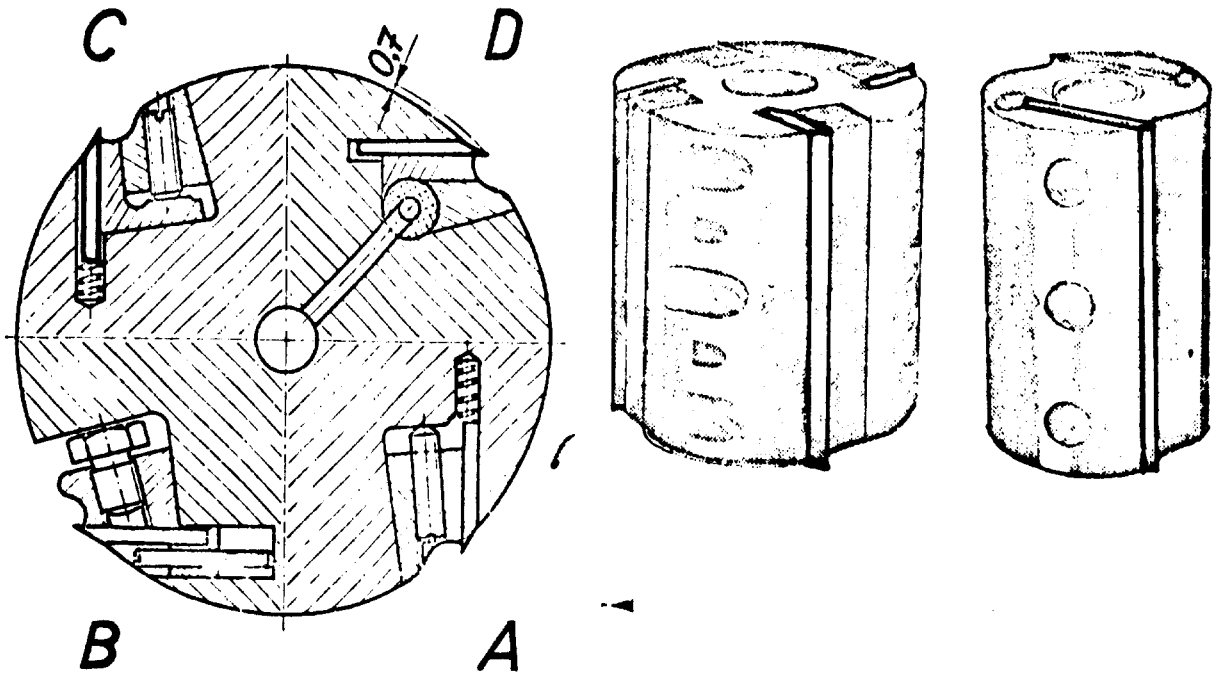
$$S \leq \frac{D}{1000}$$

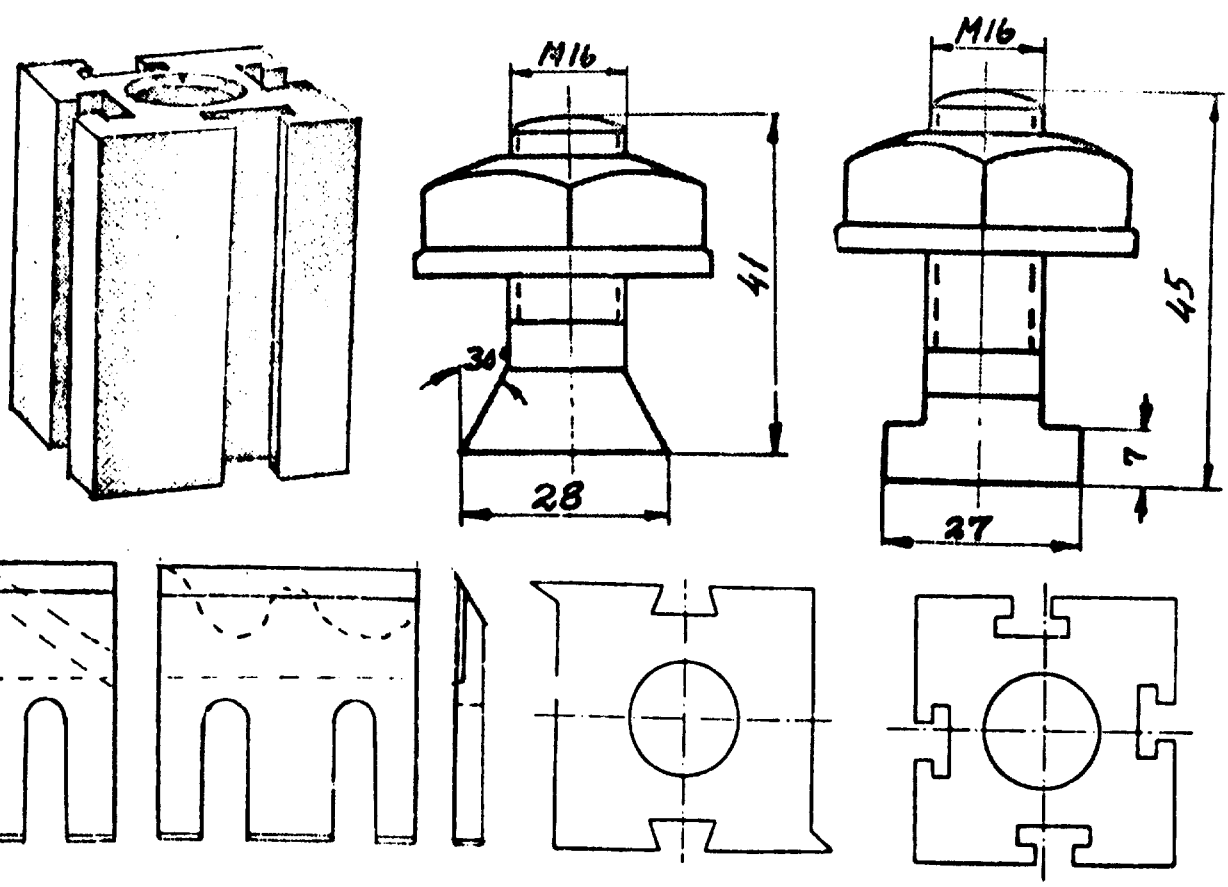


Band saw blades used in furniture work

Figure 10

4-knife 2-knife
Different ways of mounting circular cutter-blocks

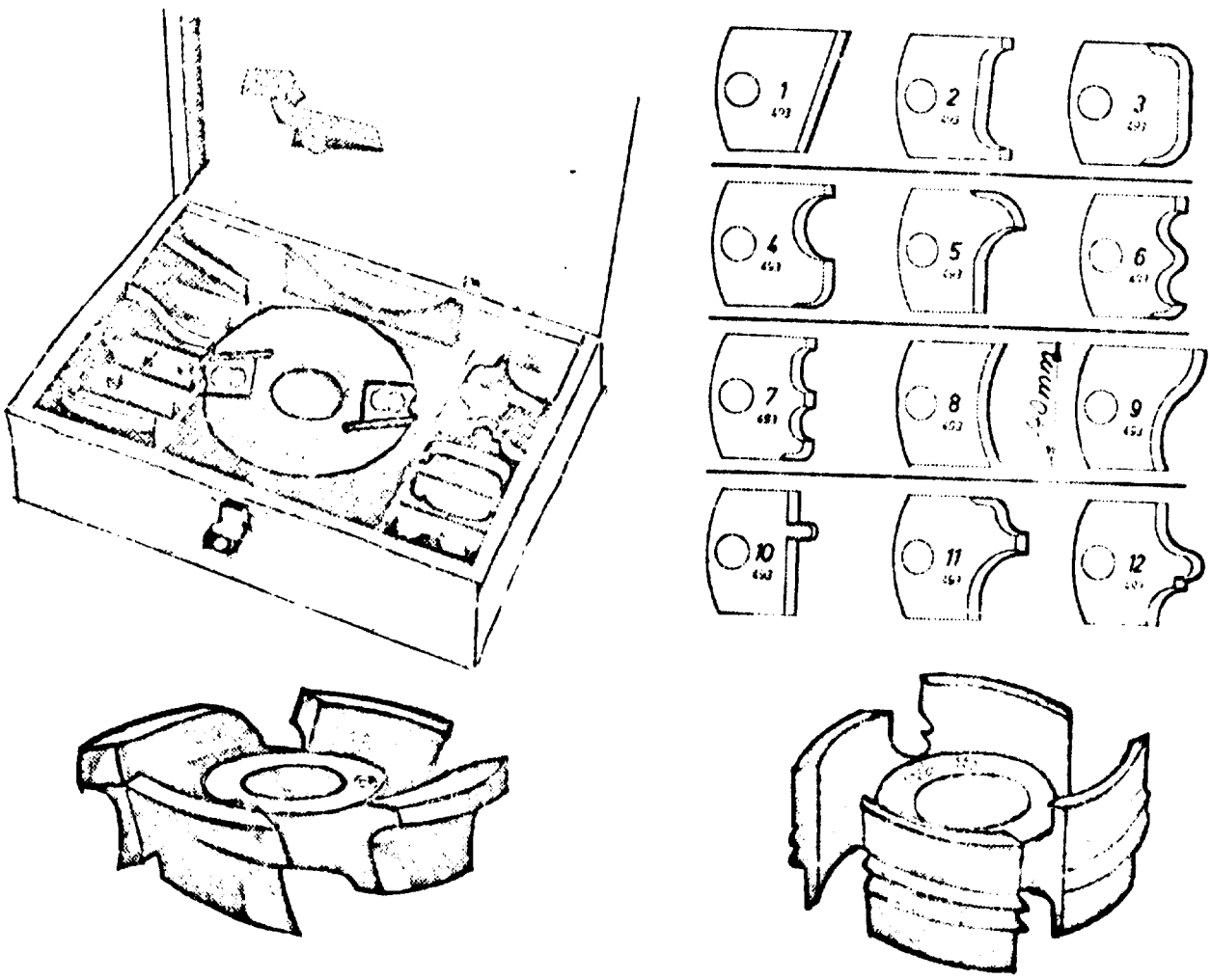


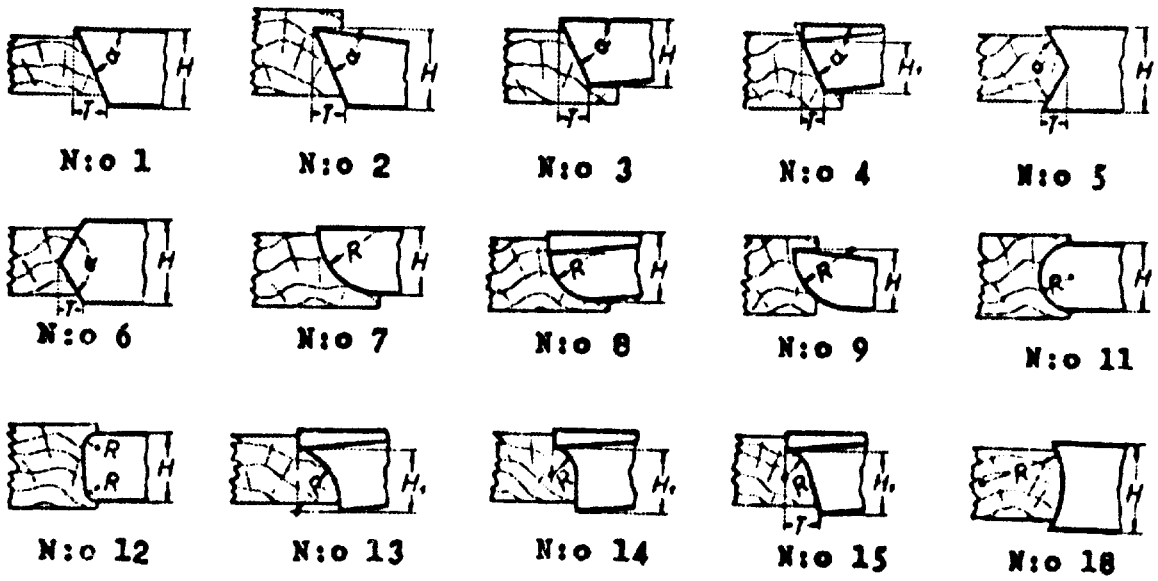


Square cutters

Figure 11

Circular moulding cutter with profile knives



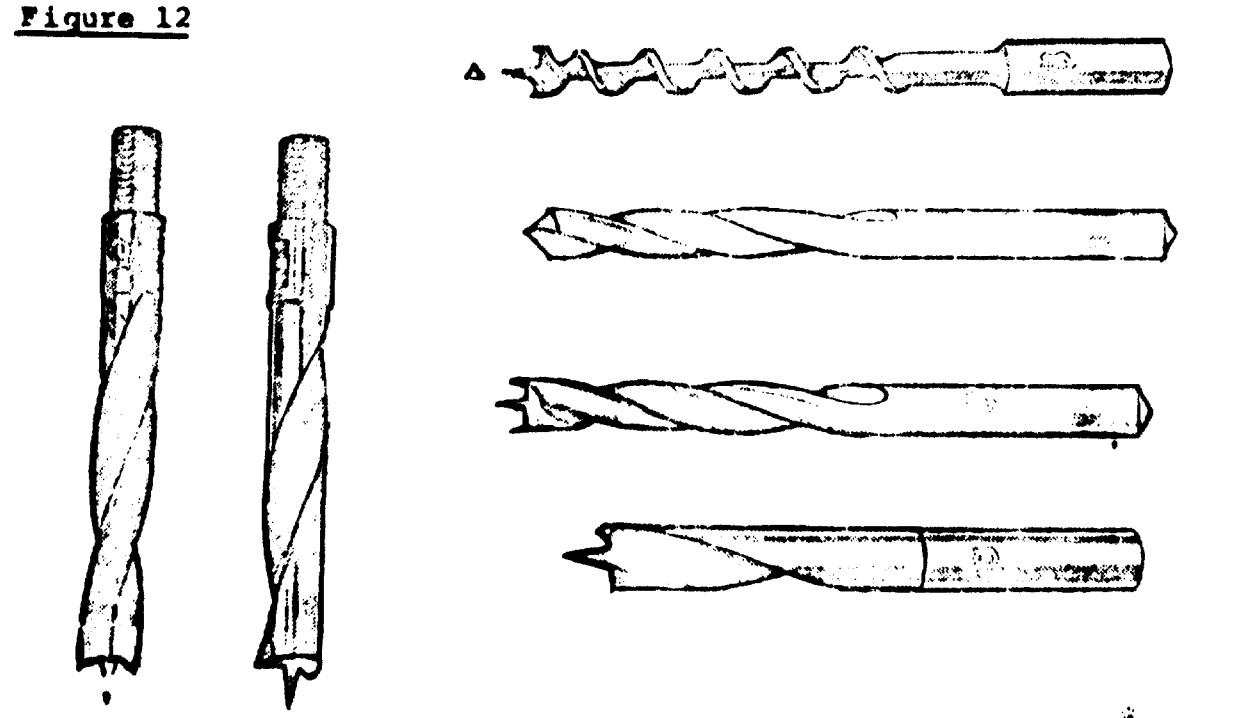


Solid profile cutters

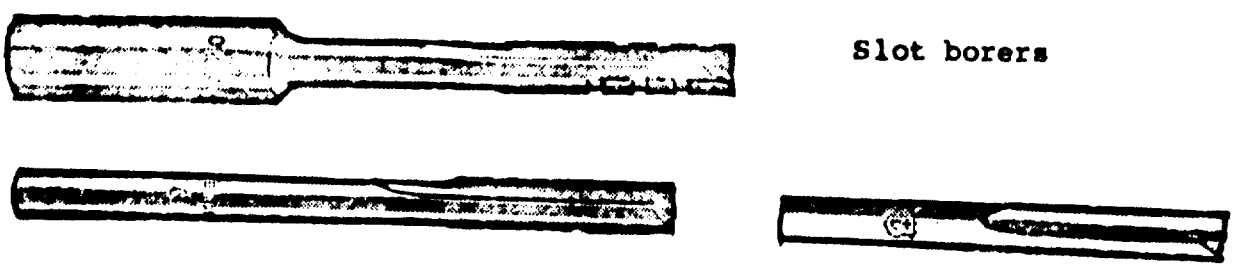
Borers and mortisers

Spiral borers

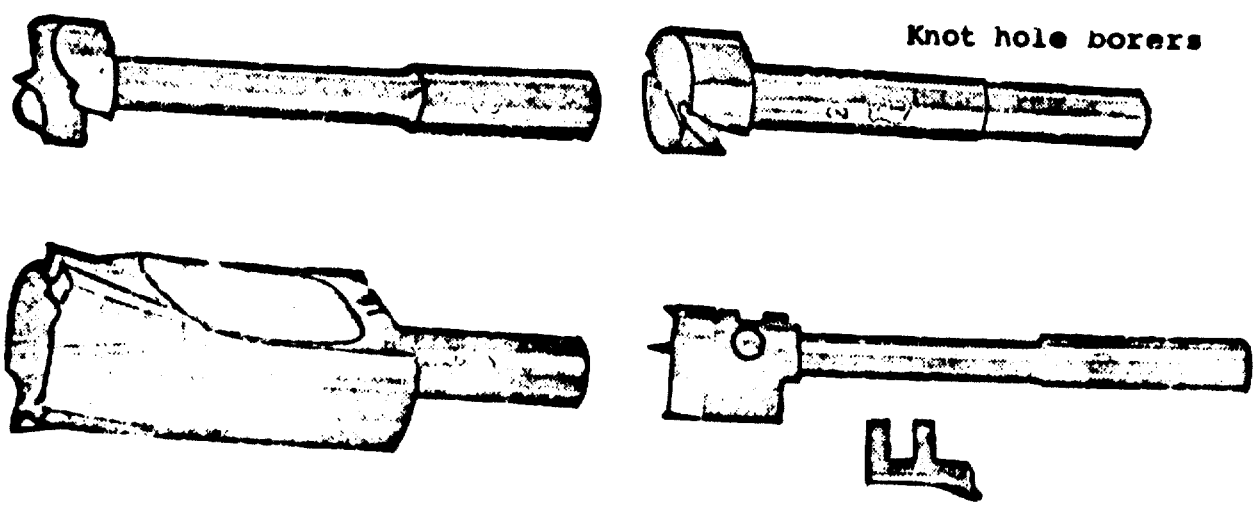
Figure 12



Slot borers



Knot hole borers

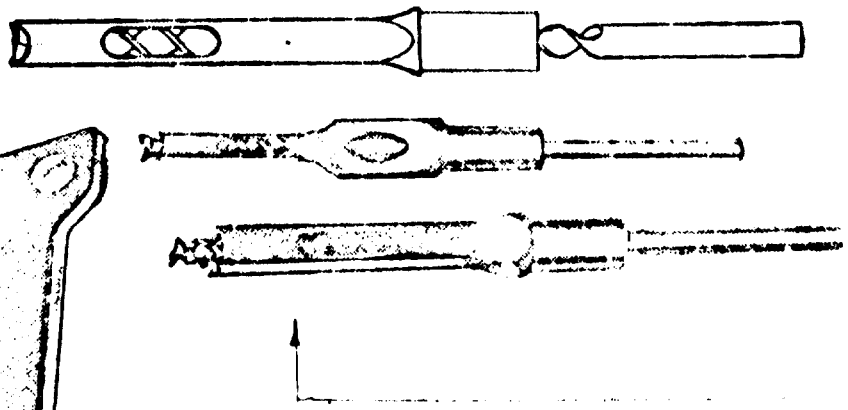


Knot hole borer

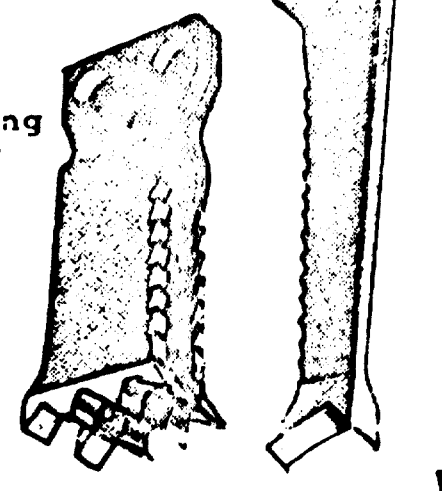
Adjustable borer

Hollow chisels

Figure 13

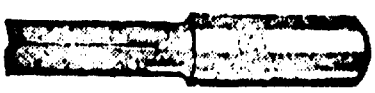


Oscillating mortising chisels



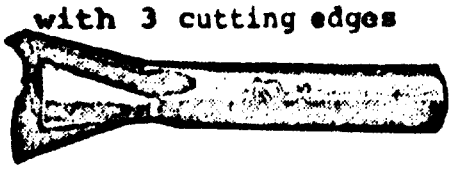
Router cutters

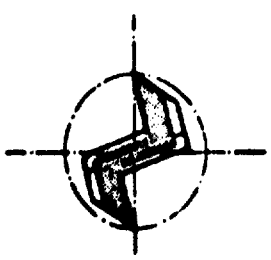
with 2 cutting edges

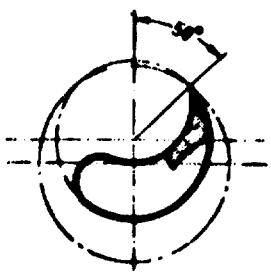


with 1 cutting edge

with 3 cutting edges

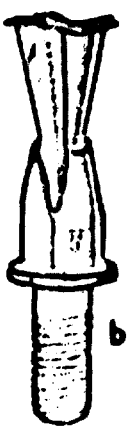




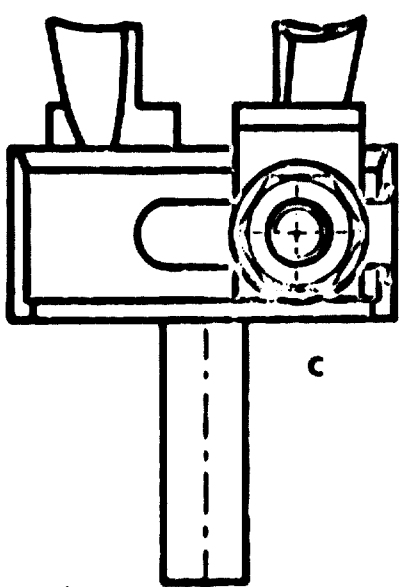


Equipped with spur cutter

a



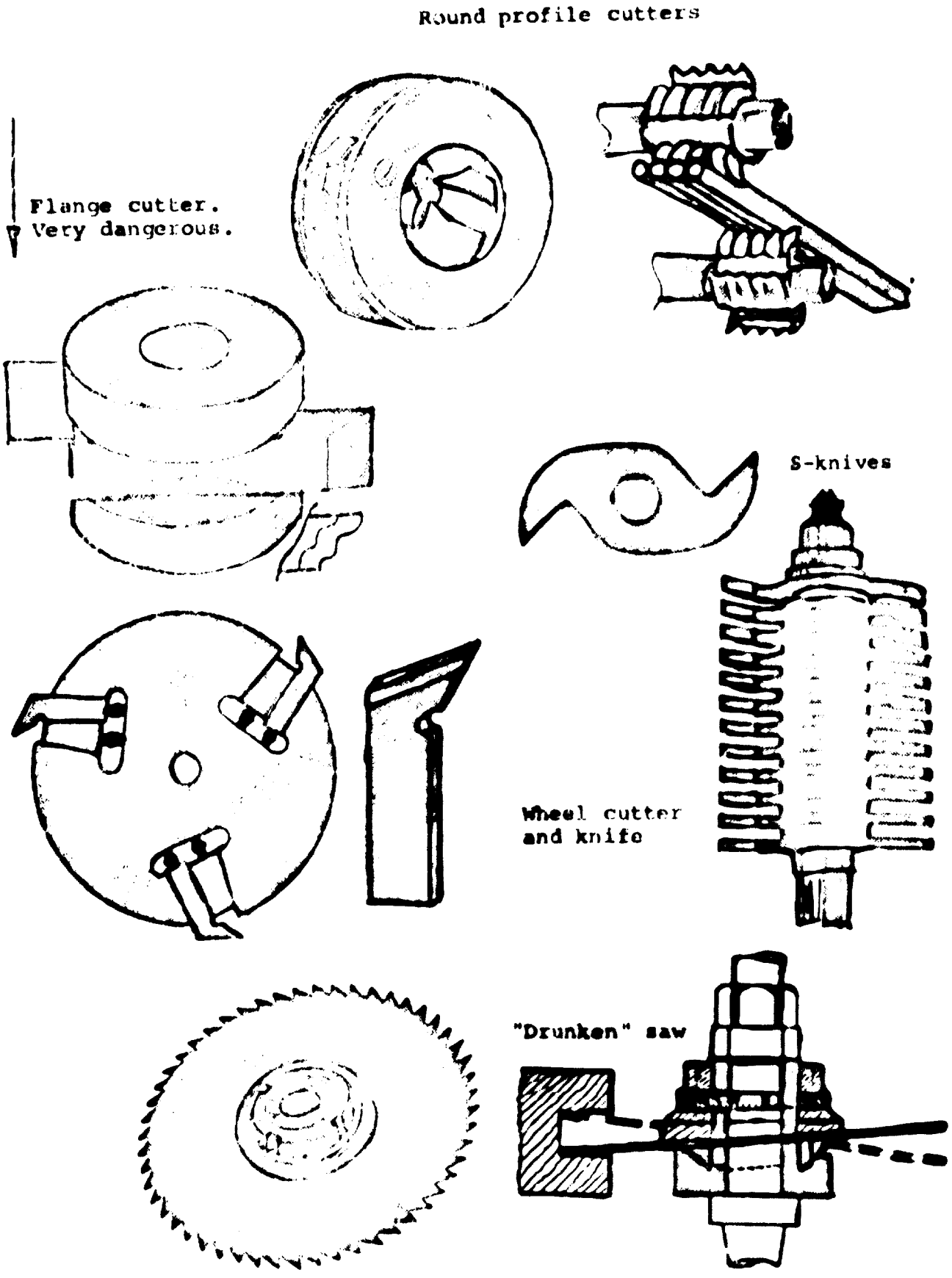
b



c

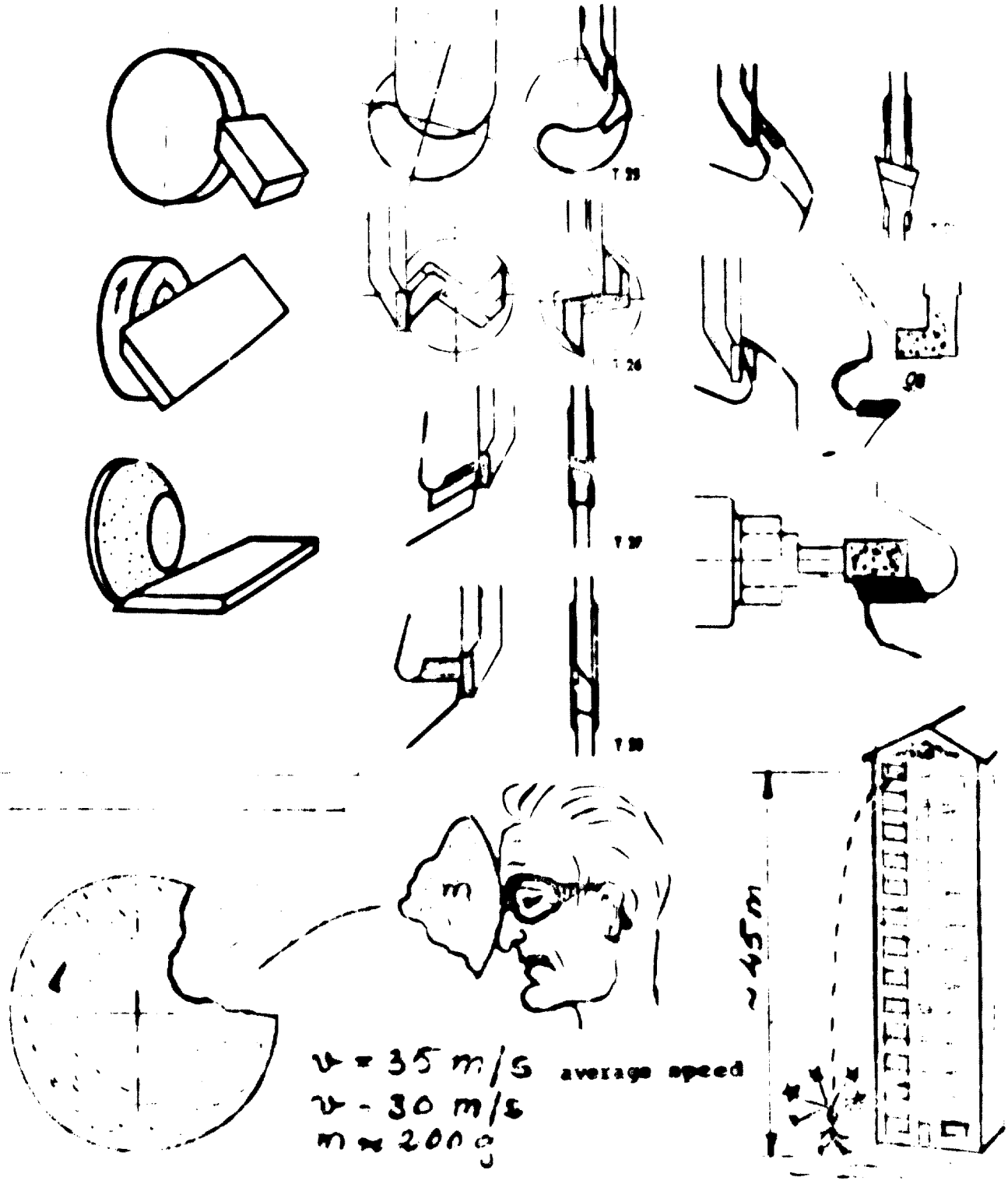
Adjustable groove router

Figure 14


Round profile cutters
Flange cutter.
Very dangerous.
S-knives
Wheel cutter
and knife
"Drunken" saw

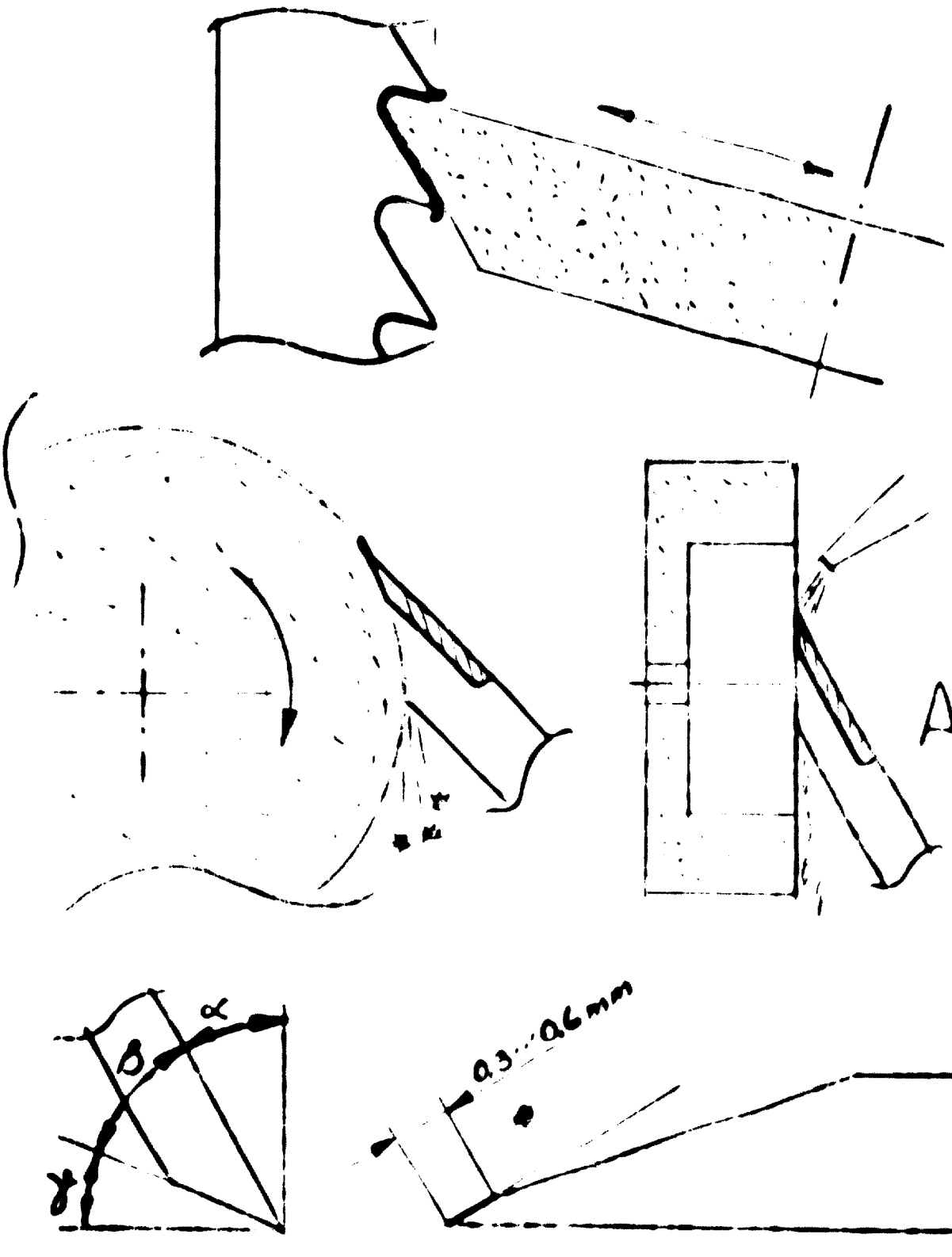
Separate wheel for each profile

Figure 15



Broken grinding wheel without cover

Figure 16 Too fast feed rate in grinding



Knife angles

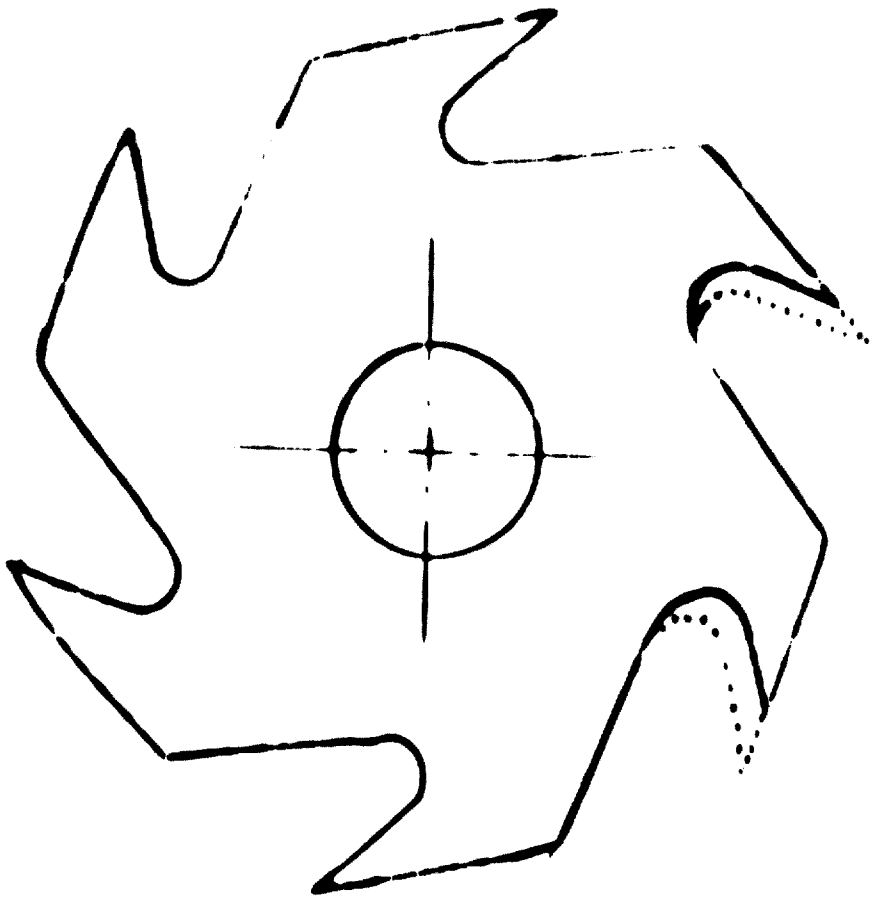
Microbevel

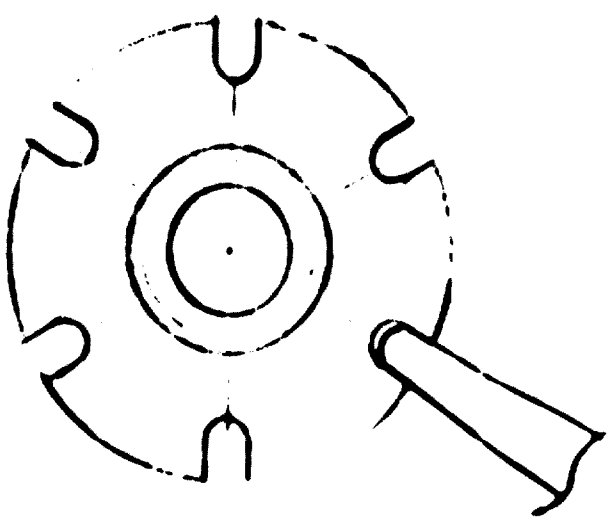
Dry grinding

Wet grinding

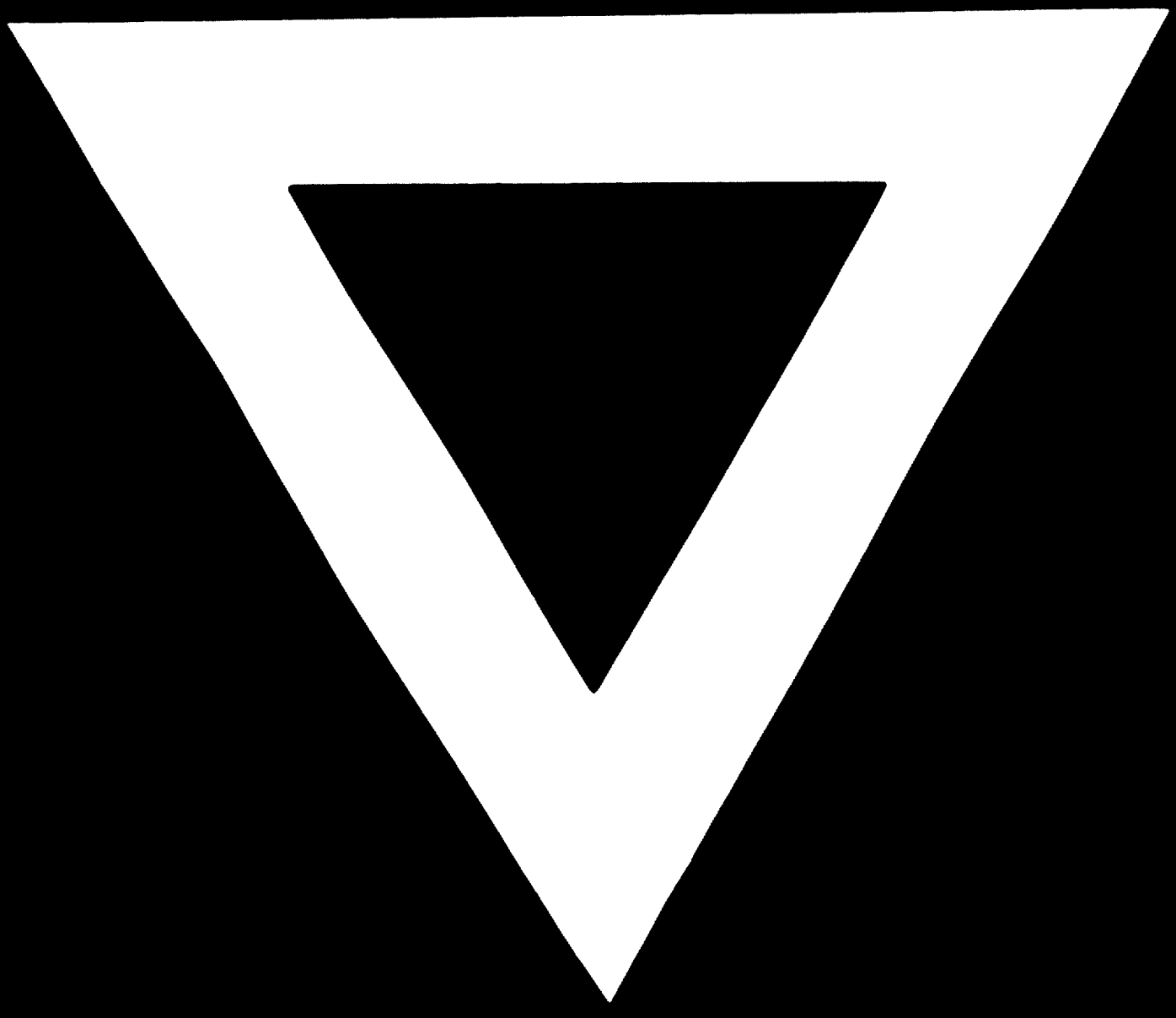
Figure 17

Manually ground
Held in hand during grinding





Pitch controller exact. Tooth distance remains the same.



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