1- Introduction

The clamping system must constrain the w.p. against the cutting forces without damaging it or causing inaccuracies.

2- Plate clamps

The clamps shown so far have all been secured by hexagonal nut and spanner; this is acceptable when a high clamping force is necessary as when milling and when turning, but a hand-operated nut is better if it permits the required force to be applied. The hand nuts should be long enough to allow the operator to grip it in comfort. The hand nut can be machined from bar, but the manufacturers of 'unit tooling parts' market small cut hand nuts of the type shown in Figs. 4.13 and 4.16.
2

4- Direct clamping

- Floating pads

- Direct clamping using a post

- Quick action nuts

5- Hook bolts

6- Clamping plates
7- Clamping more than one workpiece

A plate clamp can secure no more than two workpieces at once owing to variation in workpiece height.

Spherical washer is better

8- Differential Clamping

In the clamping system shown, the actuating plate is moved towards the workpiece by the clamping screw, and it operates the two clamps by wedge action. Variation in the position of the workpiece may be allowed for, because as soon as one of the clamps touches the workpiece, further clamping causes the actuating plate to move at right angles to the screw movement. Once the system is set, the continued movement of the screw produces equal clamping forces on the sides of the workpiece.

9- Cam-actuated Clamping

Cam-actuated clamps are very rapid to operate, but care must be taken to ensure that the cutting action will not loosen the clamps.

10- Toggle Clamps

Toggle clamps are very rapid to operate and give a secure clamping action.

11- Pneumatic Clamping

The advantages of pneumatic clamping are:

1. There is less wear on the clamps and associated parts
2. There is less tendency for damage to occur to the workpiece
3. The operation is more rapid
4. The clamping pressure can be controlled more accurately.

Used to operate two clamps and produce equal clamping forces.
From pneumatic
As an alternative, the clamping force can be produced by powerful spring, and the air used to release the clamps as shown in Figs. 4.48 and 4.49.

12- Hydraulic Clamping
In general, the principles are the same as those associated with pneumatic operation. The pressure oil being either supplied by the machine itself or by pump.

* As an alternative, the clamping force can be produced by powerful spring, and the air used to release the clamps as shown in Figs. 4.48 and 4.49.