CHAPTER I

Historical Aspects and General Description

AT THE BEGINNING of the 19th century, the only way to produce a flat surface other than by hand, was to mount the work in the lathe, preferably bolted to the faceplate, and turn it; a cumbersome business. Industrial needs soon led to the introduction of independent machines that would do the work, the first of these being attributed to Richard Roberts 1789-1864.

Roberts' invention was really a planing machine designed to deal with relatively large surfaces being followed by designs from Matthew Murray (1814), Joseph Clement (1825) and others who were gradually improving the machine. It was not until the Great Exhibition of 1851, however, that the shaping machine, substantially as we now know it, was introduced in a collection of machine tools such as had never been seen before. Both in design and finish their quality was outstanding. The producer of these machines was Joseph Whitworth, whose name and whose firm was to remain in the forefront of engineering progress for the rest of the 19th century.

The Shaping Machine – General Description

The basis of the shaping machine is an iron casting supporting slides in which a ram can move backwards and forwards, the ram carrying a cutting tool to machine work mounted on a work table or knee also attached to the main casting. The ram itself has a slide that permits the tool point to be brought into contact with the work surface and the depth of cut to be adjusted. These basic elements are depicted in the illustration Fig. 1.

The Main Casting

For the most part the main casting provides a seating for the ram and another for the knee supporting the work table. In addition, when the unit is power-operated, the casting contains the mechanism used to drive the shaping machine, whilst the components

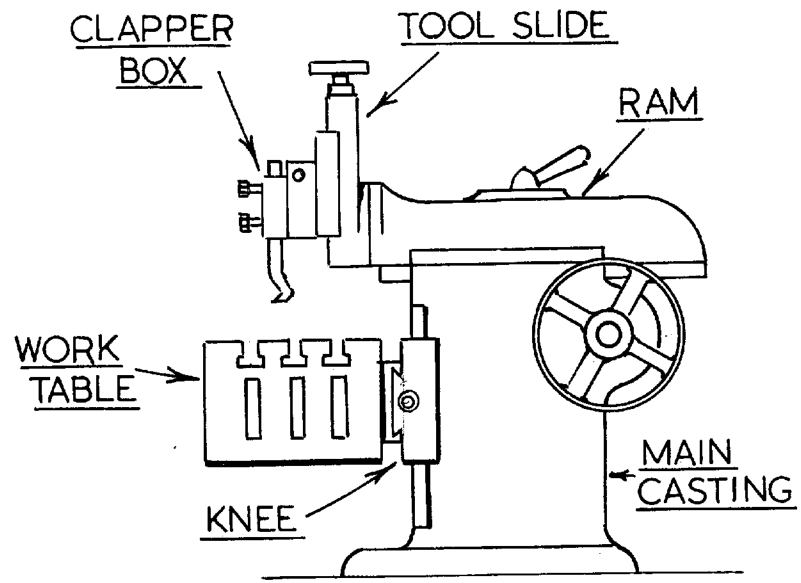


Fig. 1 Basic Elements of the Shaping Machine

that comprise the automatic feed for the work slide are bolted to the outer surface of the main casting.

The Ram

The main moving element in a shaping machine is the ram. This carries the tool slide, moving in ways machined in the main casting which is provided with a series of adjusting screws to enable any shake in the ram itself to be taken up.

In the majority of power-driven machines both the stroke of the ram and its position in relation to the work may be adjusted. When the shaper has a variable speed facility, stroke adjustment is of great importance. It will be apparent that, supposing a narrow width component is being machined, one can cut down the length of the stroke until it just embraces the work in hand. For example, let us suppose the work is but a quarter of an inch wide. Then the stroke of the ram would be set to $\frac{3}{8}$ in., leaving an overlap of $\frac{1}{16}$ in. each side of the work, a setting that would probably allow the shaper to be used at its maximum speed. This matter will be dealt with in greater detail later.

The Tool Slide

At the end of the ram directly above the work table is fixed the tool slide. This slide is similar to the top slide of a lathe in that it carries the cutting tool and, again like the top slide, may be set at an angle each side of the normal zero. In this way work may be cut down to any angle within the machine's capacity. In large machines the tool slide may be power operated.

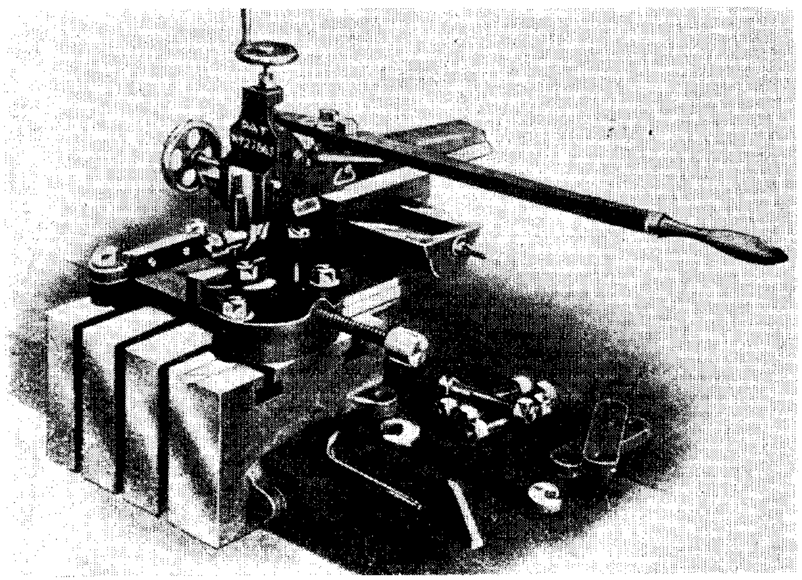
The tool itself is mounted on the face of the slide in a special fitment called the clapper box.

The Clapper Box

While the cutting tool in a shaping machine must be rigidly mounted, it is essential for many purposes, that, on the return or non-cutting stroke, the tool point should be relieved of load. This is the function of the clapper box seen in a typical form dismantled in Fig. 2. It consists of an assembly consisting of a box fitted with a hinge pin, usually tapered so that any shake can be taken up, and a clapper that hinges on the pin. The clapper is provided with a seating for the tool, which in the example illustrated is held in place by a pair of set screws. There is another form of tool holder used with the clapper and this will be described in a later chapter.

In the illustration it will be observed that a curved slot is machined in the backplate of the box. Its purpose is to permit the box to be swung a few degrees either side of the vertical. This provision is

Fig. 3 Bench Shaper circa 1912



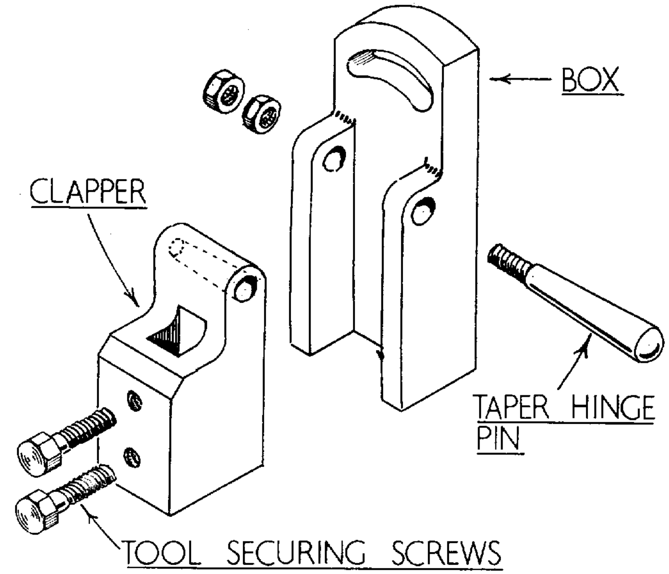


Fig. 2 The Clapper Box

necessary in order to prevent the tool from jamming on the return stroke when machining overhanging work such as a machine slide. A set screw passes through the slot into the body of the tool slide and is used to clamp the box which pivots in the slide itself.

The Knee and Work Table

This is the second main slide assembly of a shaping machine. The knee itself slides vertically on the main casting, a jack screw being provided to control its movement. The knee also contains the horizontal slide upon which the work table moves under the action of a feedscrew. This feedscrew is the most important in all shaping machines. Even in the simplest of machines this feedscrew is used to move the work under the point of the tool, and, for the most part, is made to work automatically.

There are two forms of shaping machine. In the first the work travels on a moving table past a reciprocating tool, in the manner already illustrated. In the second the work table is stationary, and it is the ram assembly that moves along to allow the cutting tool to cover the work surface. A typical example is the machine illustrated in Fig. 3. This is a bench hand-powered shaper with a work capacity 9 in. by 9 in. Its maker is unknown but it appeared in many tool merchants' catalogues in the early part of this century and one was in the authors possession for some years from 1925 onwards. In every way an excellent little machine it had no frills but all the essential facilities were there and it was very comfortable to use. One particular provision was a V-groove machined directly into the work table. This was intended for the mounting of shafts so that keyways could be cut in them.

Locking the Clapper Box

However, we must now return to further consideration of matters concerning the clapper box. The particular example depicted in the illustration Fig. 2, and known as the English pattern, has a tool holder consisting of the clapper itself in which a square section hole to receive the tool is machined. Because of this feature the usefulness of the English clapper box is somewhat restricted and so has largely given way, in the smaller machines at all events, to the American pattern.

Here, as may be seen in the accompanying illustration Fig. 4 the tool is held in a clamp resembling the type in common use on American lathes. This comprises a lantern fitted with a set screw to hold the tool in place and a hardened steel washer through which the lantern is passed and against which the back of the tool presses.

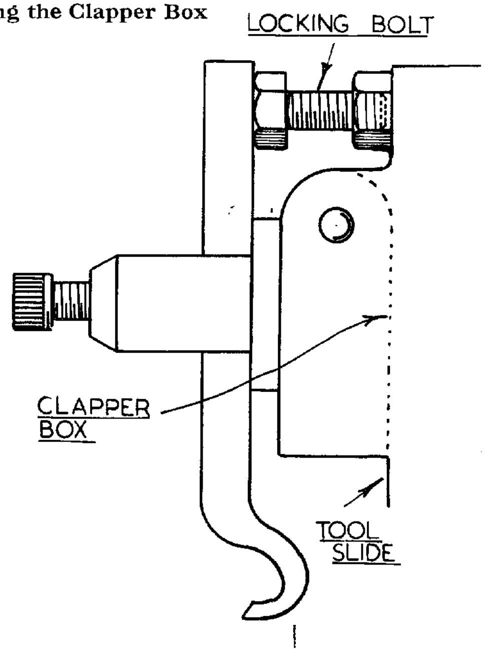


Fig. 5 Improvised method of locking the Clapper Box

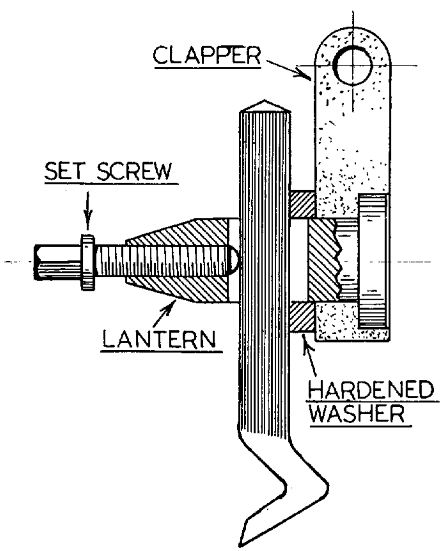


Fig. 4 American-type toolpost

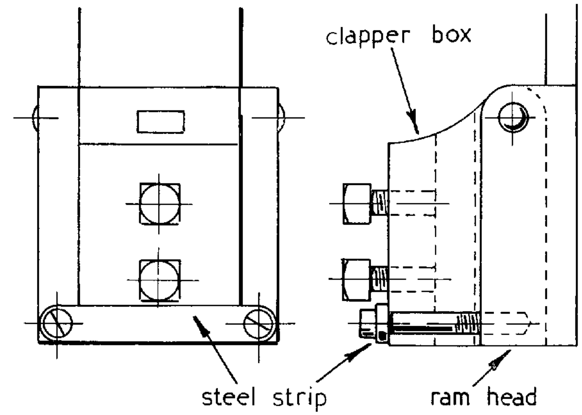


Fig. 6 Permanent method of locking the Clapper Box

The lantern is of round section and is shouldered at its inboard end so that, when passed through the clapper, it is pulled against the back of it as soon as the set screw is tightened against the shank of the tool.

It will be clear that this type of tool holder allows the tool itself to be swung around to approach the work at any angle desired. For this reason, as in the case of the lathe, this type of tool holder has come to be preferred.

As will presently appear there are certain operations in the shaping machine that call for the clapper box to be locked, and all relief to the tool on the return stroke eliminated. In the case of the English pattern clapper box, as with the American type, this can be done in two ways. In the first, as an improvised measure, a short bolt with nut can be introduced between the back of the tool at the top and the face of the stationary member of the clapper box as shown diagrammatically in Fig. 5.

The second and permanent method is depicted in Fig. 6. Here the clapper is restrained from movement by a steel strip passing across its face and held in place by a pair of screws tapped into the linings of the box.

Where the American pattern clapper box is concerned locking it is a very simple matter. All that is required is a single screw, securing the clapper in the box so that it cannot move. The screw is passed through the clapper into the back of the box in the manner depicted by the illustration Fig. 7.

The position of the lock-screw as shown in the illustration is not ideal, but, for the most part, this location is dictated by the position the lantern occupies on the clapper. As the lantern is usually set low down on the clapper, there is then no room to put in the set screw at its most efficient point. So a compromise position has to be chosen, and this is the one shown in the diagram.

The Self-Act

In order to machine a piece of work completely the work table needs to be moved along, so that as it travels backward and forward, the cutting tool can fully cover the work. At the same time the tool itself needs to be fed to the work under controlled conditions. Both these requirements must be met by properly designed machine slides. In many large professional shaping machines both of these slides are provided with an automatic feed, usually called "The Self-Act". In small machines, however, and with hand-powered shapers in particular, the self act is confined to the lead screw of the work table. The details of the mechanism necessary are given in the chapters dealing with hand and power-driven machines, whilst an automatic down-feed, that the author has fitted to his own power shaper, will be described in a later chapter.

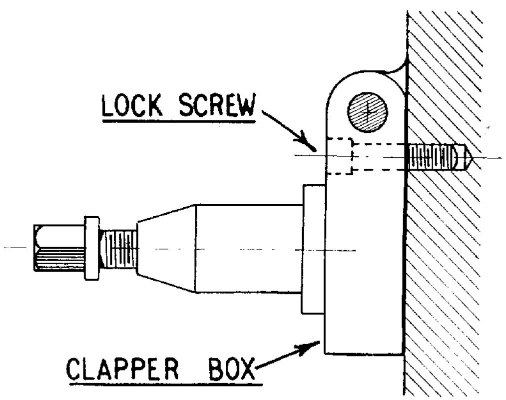


Fig. 7 Locking the Clapper Box with American Tool Post

CHAPTER 2

Hand Power Machines

FOR MANY PURPOSES in the small workshop a shaping machine operated by hand will suffice quite well. In years gone by, as any comprehensive tool catalogue of the time will confirm, there were many hand shapers to choose from. A typical example, from the catalogue of Richard Melluish dated 1912, is illustrated in Fig. 1.

The machine has a large cast base plate provided with T-slots that are used to house the bolts securing the somewhat elimentary machine vice seen in the illustration. The vice consists of a pair of angle plates, one having a moving plate that can be used to grip any work that needs machining. The angle plates can be turned through 90 degrees to the position shown, enabling work to be machined against the standing jaw as and when required.

Fig. 1 Shaping Machine 1900-1912