In Praise of the Shaper

If one was to carry out a survey of model engineers, it is probable that their order of preference in machine tools would place the lathe at the top of the list, with the milling machine second.

Many would likely go no further than that, since most jobs can be tackled by one or other of these machines. For many people, there is a pride to be had from the range of tasks that can be carried out with a lathe which has a good range of accessories and they might consider a milling machine to be an extravagant extra.

There is one machine tool which is well worth considering, even though it is seldom mentioned, either by model makers or for that matter full time machine shop personnel. If a workshop has one of these machines at all, then it is usually tucked away in a corner and ignored. In fact, machine tool dealers virtually despise these tools and resent the floor space taken up by them. For that reason they are frequently available very cheaply, and if you are lucky enough to buy one and discover its virtues, you will consider your money to have been well spent. By the time you have acquired or manufactured a few accessories for the machine, you will wonder how you ever managed without it. Some readers will by now have guessed that I am referring to the shaping machine.

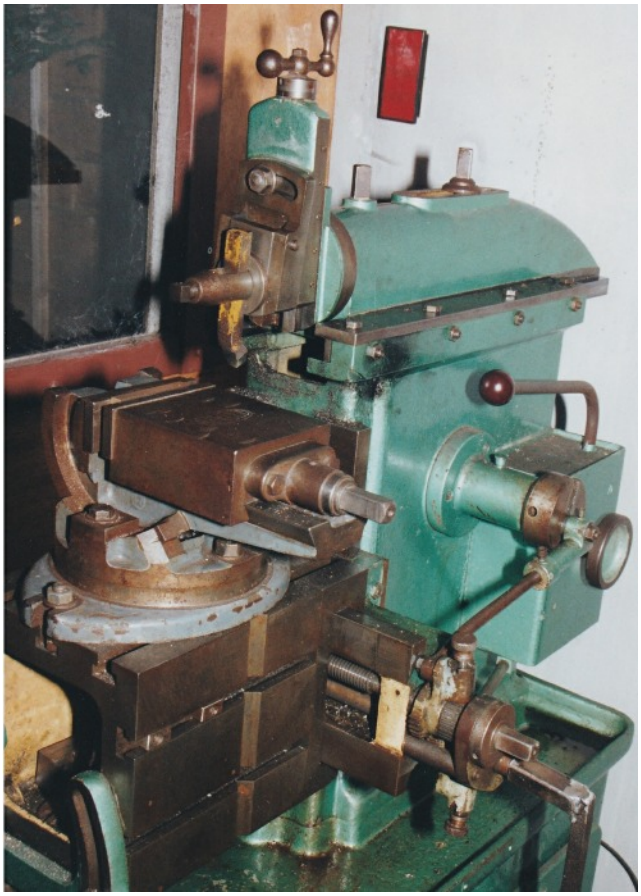

Photo 1. A general view of the "Royal" shaping machine.

My own shaper shown in Photo 1, is a small 'Royal' machine, which is of a size that was used by many schools in the days when the education system placed some degree of importance on the development of manual skills. No one would ever have persuaded me to buy the machine in the first place, I was satisfied that I could tackle all my jobs with the milling machine and lathe, - an almost correct stance.

The shaper came to me through a deal which went wrong. I accepted it in part payment from a firm which went into receivership. Thus, it stood in a corner as a painful reminder to be careful who I trust, waiting for an opportunity for me to get rid of it! It would probably still be unused except for the day when the milling machine had a difficult job set up in it and I needed a flat surface machined on another component. The attraction of the shaper started to come home to me.

First and foremost is its use of simple lathe type tools. For those unfamiliar with the shaper, have a look at the first photograph. It consists of a table, usually in the form of a box with Tee slots on at least two sides. The table can normally move left or right and up or down.

Immediately a similarity between the shaper and a milling machine emerges. The shaper table however does not have a third axis of linear motion. The third axis is used by a ram at the top of the machine, which slides backwards and forwards carrying the cutting tool to and fro across the workpiece. All these features are easily inferred from the first photograph. The cutter itself is mounted on a 'Clapper-box'. This is a pivoted block which allows the cutter to ride up over the workpiece on the return stroke. There is an automatic feed mechanism which advances the workpiece prior to each cutting stroke. In this way the job passes across in front of the cutter producing a f1at surface. The second photograph is of a Stuart 'Double Ten' baseplate being machined.

Photo 2. Shaping the top of a Stuart Double 10 stationary steam engine bedplate.

With the job set up in the shaper, other advantages became apparent. The power consumption and noise level were much lower than that from the milling machine, and the slow rhythmic action of the shaper was almost restful. It made a pleasant change from the whine of milling. The shaper could also be left unattended for long periods as it worked its way across the job. In fact, the machine is so simple to operate, that the bedplate illustrated was machined by my five year old son Jim.

The increase in productivity available from the possibility of operating two machines simultaneously was another great advantage. Providing work flows could be conveniently arranged, the shaper would soon earn its keep. After all, why should large companies be the only ones to benefit from efficient working practices? The amateur deserves every bit of help he can give himself.

To return to my description of the shaper itself, there are a few features which are not immediately apparent from the photographs. The table on which the workpiece is mounted can be tilted about 15 degrees either side of the horizontal. This enables the operator to generate flat surfaces at an angle to one another. Some large shaping machines have fully universal tables which can tilt in two directions. My own preference is to achieve the same flexibility by employing a swivel and tilt machine vice as illustrated in Photograph 1.

On the Royal Shaper illustrated, there is a pair of levers on the side of the machine. The upper lever engages the drive to the ram. The lower lever, which is only partly visible, is a gearchange for selecting either of two ratios. There is a drive on the other side of the machine with a pair of pulleys giving a total of four speed settings for the reciprocating action of the ram.

A small handwheel on the side of the shaper toward the back allows the operator to position the ram whilst setting up the machine. Just to the front of the handwheel and slightly above it is the drive for the automatic feeds. The amount of feed for each stroke is adjusted by varying the degree of eccentricity at the drive end of the feed rod. However the feed steps across in multiples of about 0.010” determined by the number of ratchet teeth. At the driven end, there is a spring loaded plunger which can be rotated through 360 degrees to set the feed direction for the ratchet or disengage. On the Royal there is a pair of these plungers and the user has the option of feeding the table in a vertical direction instead crosswise.

Looking now at the ram itself, the graduated hand feed and slide for the toolholder is the most prominent feature. This gives 3" (75mm) of travel and can be swivelled to any desired angle. Graduations are marked for up to 60 degrees either side of the vertical position. The swivel feature can be used to augment the facility of the tilting table. However, it has other important uses to which I will refer later. On the top of the ram is the bolt which allows the centre of the stroke to be positioned in relation to the workpiece. The one other adjustment of importance is the length of stroke itself. This is set by altering the eccentricity of a slider block located inside the shaper body.

As I mentioned earlier, the shaper uses lathe type tools for its operation, which gives it an immediate edge over the milling machine for some classes of operation. If consideration is given to the cost of end mills or slot drills against that of lathe tools, the shaper's advantage is clear. It is also a straightforward matter to resharpen lathe tools. There is one point of caution here which is in a sense a latent advantage. The action of the shaper requires that the tool withstands impact on each stroke. For the most part one should not attempt to use carbide tipped tools for this type of operation. There are some grades which will operate satisfactorily, but many will quickly splinter. The advantage is that most model engineers will have some old high speed steel lathe tools lying around unused. The shaper gives them a new lease of life. The recommended clearance angles for a shaper tool are slightly different to those recommended for similar materials on the lathe, but I have found that tools ground for turning operations are quite satisfactory for my purposes.

Machining flat surfaces on metal may not appear to be a tremendously useful and compelling reason for buying a machine tool, but a keyway is simply a flat surface recessed in a shaft and a spline can be generated by a series of such flat surfaces. If necessary, the profile of the cutting tool can be ground to give the required form. Photograph 3 shows that cutting internal splines or keyways is as easy for the shaper as cutting external ones.

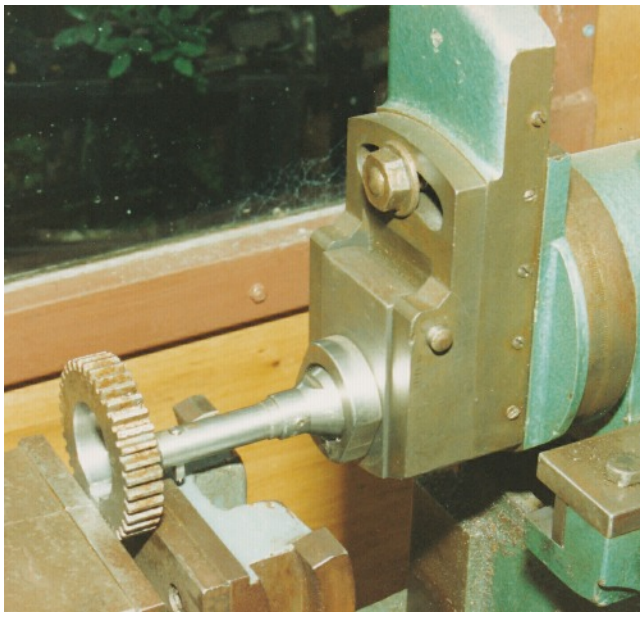

Photo 3. Cutting a keyway in a gear.

A specially adapted toolholder is shown in use, cutting a keyway on a gear. Slotting attachments are available for milling machines, but they are uncommon, and likely to cost more than a good quality second hand shaping machine.

It is a small step from the above illustration to realising that the shaper can be used for manufacturing racks and gears and it is here that the swivelling facility on the toolholder slide comes into service.

As with screwcutting on the lathe, the angle of the slide is set to arrange that cutting only occurs on one face of the tool, so that it does not jam. Of course, the milling machine can be used for most of these operations, and I don't doubt that many operators would prefer to use a milling machine for gear cutting. It is quite acceptable to use a profiled fly cutter for making gears but without a slotting attachment tackling internal jobs is not practical.

The reciprocating action of the shaper cries out for an accessory that places it in another class altogether. A grinder mounted on the ram, as shown in Photograph 4, permits surface grinding to be done to a standard that is up to all but the most demanding of jobs. It also forms the heart of a very useful tool and cutter grinder.

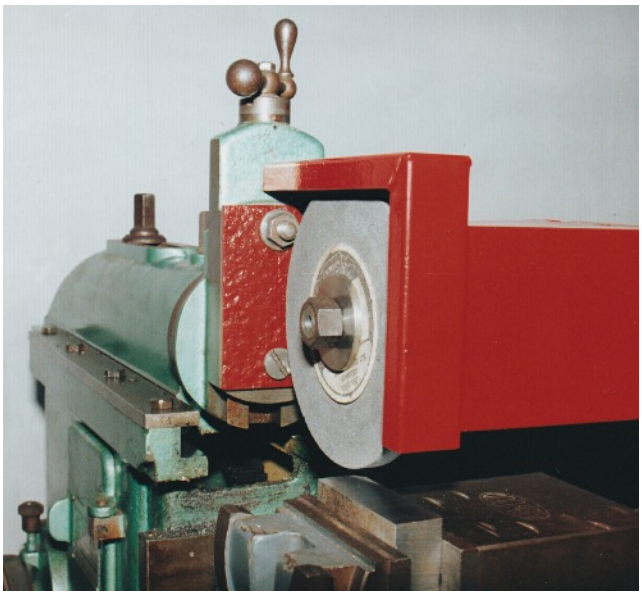

Photo 4. The shaper rigged as a surface grinder.

By setting the toolslide over to approzimately 5.7 degrees above horizontal, a 10:1 reduction in the vertical feed is achieved. Thus an advance of 1 thou on the toolslide gives a grinding cut of 1/10th thou. Consequently the shaper can be used for finishing operations which demand a high degree of accuracy.

These illustrations only represent a part of the range of jobs that the shaper can tackle. Photograph 5 illustrates the shaper being used as a power hacksaw.

Photo 5. The shaper takes the strain out of hacksawing and brings a high degree of accuracy to the process.

I have the option of using the bandsaw in my workshop, but the shaper serves particularly well when removing stock from small components. The adaptor shown was designed to make use of broken bandsaw blades which are heavier gauge and broader than those used with a hand held hacksaw.

As with many simple tools, the range of applications of the shaper is more likely to be limited by the imagination of the user than by any intrinsic design feature.

With an alternative power head, and other suitable adaptations, the shaper might well serve as a surrogate milling machine.

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