Final Diploma

Patent Examination Board

Drafting of Specifications FD2 (P3)

Thursday 20 October 2016 10:00 to 14:00

INSTRUCTIONS TO CANDIDATES

1. The whole assessment task is to be attempted.
2. The marks to be awarded are given at the end of the assessment task.
3. The total number of marks available for this paper is 100.
4. Start each part of your answer on a new sheet of paper.
5. Do not state your name anywhere in the answers.
6. Write clearly, as examiners cannot award marks to answer scripts that cannot be read.
7. The scripts may be photocopied for marking purposes.
   (a) Use only **black ink**.
   (b) Write on one side of the paper only.
   (c) Write within the printed margins.
   (d) Do not use highlighter pens on your answer script.
8. Instructions on what to do at the end of the examination are on the Candidate Cover Sheet.
9. Any candidate script removed from the examination room will not be marked.
10. This question paper consists of 16 sheets, including this sheet, and comprises:
    Assessment Task (1 sheet)
    Client Letter (4 sheets)
    Client's drawings (5 sheets)
    Blank set of drawings for use in your answer (5 sheets).

Assessment Task

Your client sends you the correspondence listed on the Instructions to Candidates regarding a new idea.

Your task is to prepare a complete patent specification that is ready for filing at the UK Intellectual Property Office. The specification should be drafted with a view to obtaining a UK patent.

Note the following:

a) You should assume that the client's description of the prior art in the field is complete.

b) You should not make use of any other prior art or special knowledge that you may have of the subject matter concerned.

c) You should also assume that the client's description of the device and its operation is accurate, i.e. that the device works as described.

Allocation of marks

Introduction and Description: 36 marks
Claims: 60 marks
Abstract: 4 marks
Total: 100 marks

Client letter

We are an engineering company that makes parts and accessories for machine tools. We have recently devised what we think is a new and better way of attaching accessories, such as a tool setter, to the bed of a machine tool and we would like you to file a patent application for our idea today. We will be showing the device at a public trade fair tomorrow to which we are travelling today, so we are not contactable until our return next week.

Our idea is to fix an insert within the T-slot of a machine tool bed and to have a mount that simply 'clips' over the insert using a gripping mechanism.

As you may be aware, a machine tool has a flat, horizontal table or bed. The bed typically includes a number of apertures in the form of T-slots (see Figure 1) that enable objects, such as big pieces of metal for car engine blocks, aircraft parts, etc., to be firmly bolted in place while they are being cut. A motorised spindle holds and rotates a cutting tool at high speed and the cutting process involves moving the spindle so that the rotating tool is brought into contact with the object. This motion of the spindle relative to the object is controlled by a computer controller. As you can imagine, the cutting process involves imparting massive cutting forces to the object and so bolting the object being cut to the bed is the only realistic way that these objects can be securely fixed in place so they don't move during cutting.

To cut the object accurately, the computer controller needs to know where the cutting tip of the tool is located in relation to the machine tool. This is achieved using a sensor, known as a tool setter, which includes a deflectable tool-setting disk. The location of the cutting surface of the tool (e.g. the tip of a drill bit) is measured or 'set' by instructing the machine tool to move the tool towards the tool setter. When the tip of the cutting tool makes contact with the tool-setting disk, a sensor in the tool setter tells the computer controller that it has been contacted by the tool. In this way, the machine can identify parameters such as the length or diameter of a tool and also allows tool wear, or tool breakage, to be measured.

The tool setter needs to be fixed to the bed, so it doesn't move, and its position calibrated so the controller knows exactly where it is located in relation to the machine tool. Because a tool setter is simply a measurement sensor and so is never subjected to the same large cutting forces as the object being cut, it is overkill to bolt the tool setter to the bed in the same way as the work piece being cut. However, this is what is usually done, simply because T-slots and bolts are already part of the machine tool bed.

Known tool setters are currently attached to the machine tool bed via a mount or body that is secured to the machine tool bed using the T-slots and a pair of bolts and nuts. Two bolts are positioned with their heads inside a T-slot by sliding the bolts into and along the slot via an open end of the slot. The bolts fit loosely within the slot and can be slid along the slot to the desired position of the tool setter. As an aside, the heads of the bolts are sized and shaped so the bolt is not able to rotate within the slot.

One problem with this arrangement is, if a bolt is left in the T-slot without a mount attached, it will protrude above the machine tool bed. This is highly undesirable because it can then obstruct movement of, for example, the object being cut. It is sometimes possible to remove

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the bolt from the slot but it must be slid all the way to the end of the slot which is not always possible if other objects, such as the object to be cut, block its path. Our insert, instead, is retained completely within the T-slot aperture and remains in place when the mount is attached and detached as and when required.

Another problem with bolts is that a spanner or similar is required to tighten or loosen the bolts, which means that fixing the tool setter in position can be fiddly and time-consuming. In contrast, our inserts can be left in place between cutting jobs or moved within the tool bed aperture simply using a screwdriver for when a different location or tool setter is required.

Our standard insert is rectangular and about 1cm wide, 1cm deep and 5cm long with the width and depth being a snug fit with a standard T-slot. Although T-slots are most commonly used on machine tool beds, the insert could also be used with U-shaped slots. A particular feature of our insert is that it is expandable widthways. The insert width, in its unexpanded state, is sized to fit exactly within a standard T-slot of a machine tool bed. To fix the insert, tapered screws or other elements having a tapered profile are located in each screw hole from the underside of the insert. The insert is placed into a T-slot at a desired location and the tapered screws are tightened. On tightening, the screw moves up the screw hole towards the top face of the insert with the tapered part of the screw forcing the opposing sides of the insert apart, thereby increasing the width of the insert. As the tapered screws are tightened, the width of the insert expands to fix the insert within the slot by friction. The insert may also be used with spacers or thin strips of material (shims) to increase the width of the insert so that it is able to fit and be fixed within a variety of different sized slots and apertures.

A hollow slit, which is roughly an upturned U in shape, runs all the way along the bottom face of the insert. The insert shown roughly in Figure 3 has a depth which means it is fully contained within the narrow part of the T-slot, but it would also be possible for the insert to extend downwards into the wider part of the T-slot without making any material difference to the function of the insert.

Two threaded screw holes extend from the upper surface of the insert into the slit. These screw holes flare out in diameter from the top surface to the slit to take a similarly tapered screw or threaded wedge. The upper face of our insert lies flush with the upper surface of the machine tool bed and is as flat as possible to minimise metal debris (swarf) generated during the metal cutting process from getting trapped in or around the insert. The slotted end of the screw should also come to lie flush with or below the upper surface of the insert. Of course, an insert of any suitable shape and dimension may be used.

With the nut-and-bolt set-up, the tool setter is attached to the mount and the mount is then located over the protruding ends of the two bolts and fastened in place by a nut on each bolt. Once fixed in place, the tool setter is calibrated using known techniques.

If you look at the figures, the mount has a lower surface which, in use, sits on the bed of the machine tool. Our mount has two arms that extend downwardly from the bottom of the

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mount for gripping the insert. As shown in the attached drawings, one of the arms is immovably fixed to the body of the mount and the other arm is moveable. The moveable arm is attached to the body of the mount via a pivot that is located approximately halfway down the length of the arm. You can see a tensioned coil spring between the body of the mount and a point on the moveable arm below the pivot point. The spring biases the lower end of the moveable arm in towards the central axis of the mount. Of course, it is perfectly feasible for both arms to be moveable.

As also shown in the drawings, the upper end of the moveable arm forms a manually actuated handle. Pushing the handle inwards towards the body of the mount, in the direction of the arrow, overcomes the spring biasing force and causes the lower end of the moveable arm to move outwardly and away from the body of the mount. This increases the separation between the lower ends of the fixed and moveable arms. Obviously, the distance between the arms matches the length of the insert. The mount is appropriately dimensioned so that (a) when the top of the moveable handle is squeezed towards the body of the mount, the separation between the distal ends of the fixed and moveable arms is such that the arms can pass over the ends of the insert and (b) when the handle is in a resting position, the separation between the ends of the fixed and moveable arms is less than the length of the insert.

In use, the tool setter is firstly attached (bolted) to the mount. The moveable handle of the mount is then squeezed and the mount is positioned on the machine tool bed so that the insert is located between the arms. The handle is then released, causing the lower end of the moveable arm to return to its resting position, gripping the insert and firmly holding the mount and tool setter in place on the machine tool bed. After attachment to the machine tool bed, a suitable tool setter calibration procedure can be performed.

I should point out that although we are mainly interested in mounting tool setters to a machine tool bed, our insert and mount could be used with other machine tool accessories, such as temperature sensors, cameras and calibration artefacts. However, it would not be suitable for anchoring to the machine tool bed objects that are to be cut, because of the extremely high forces to which such objects are subjected during the cutting process.

To remove the tool setter from the machine tool bed with the nut-and-bolt set-up, the nuts must be loosened and the mount lifted off the bolts. Once the nuts are released, the fixed position of the bolts relative to the machine tool bed is lost and the bolts sit loosely within the T-slot again. As a result, when the tool setter is reattached to the machine bed, the bolts must be repositioned and the nuts reattached to the bolts. As you can imagine, it is near impossible for the bolts (and therefore the tool setter) to be repositioned exactly as before. As a consequence, the position of the tool setter has to be calibrated each and every time it is removed and replaced. This increases the overall time taken to perform a tool setting and associated cutting operation, which, in turn, adds to the price of the final product. The amount of 'machine time' taken to cut an object can be very important. These machine tools

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can cost millions of pounds, so saving a few minutes during the tool-setting phase can increase the number of objects each machine can cut per day, thereby reducing the cost per object.

Unlike the known mounts that are simply bolted to the machine tool bed, our new mount is easily detached from the bed when it is not needed and then reattached in exactly the same position when it is required again. We think our customers will find this feature very useful as it avoids the need to perform a new calibration procedure (which can be time-consuming) if the tool setter has to be detached from the machine tool bed for some reason.

Client's drawings

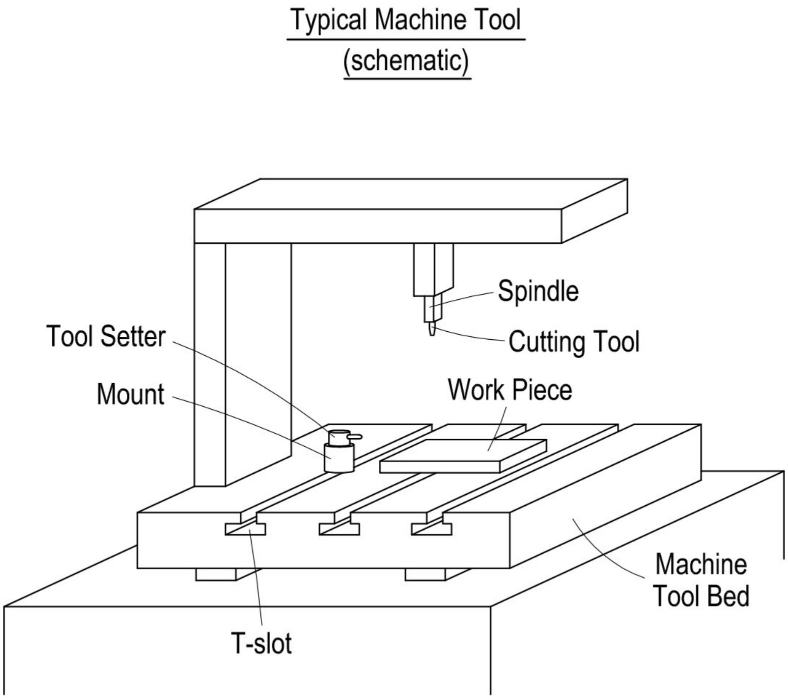

Fig. 1

Client's drawings

2/5

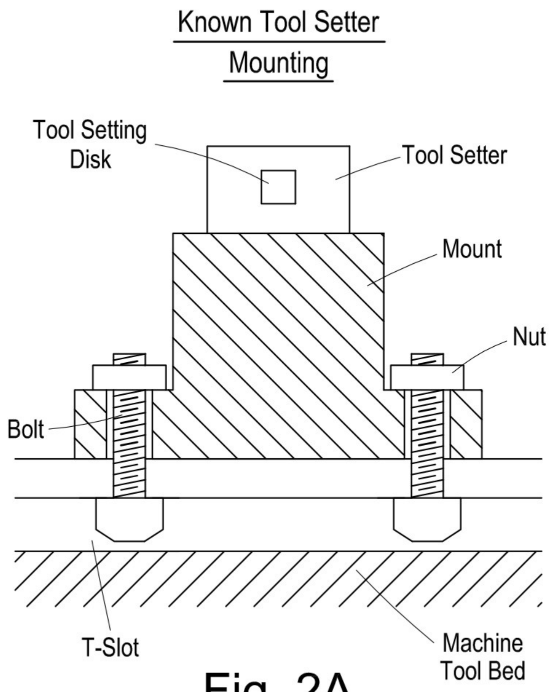

Fig. 2A

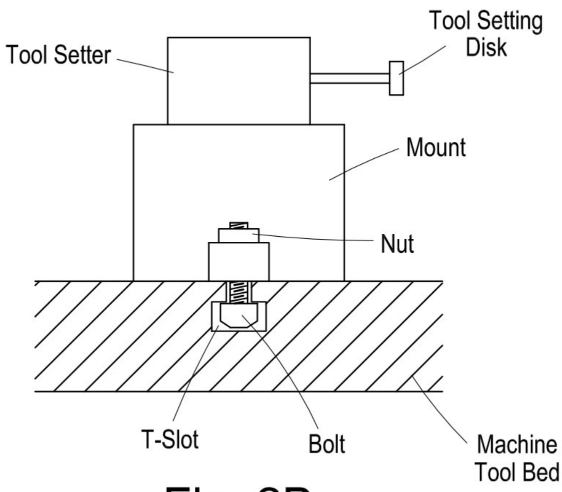

Fig. 2B

Client's drawings

3/5

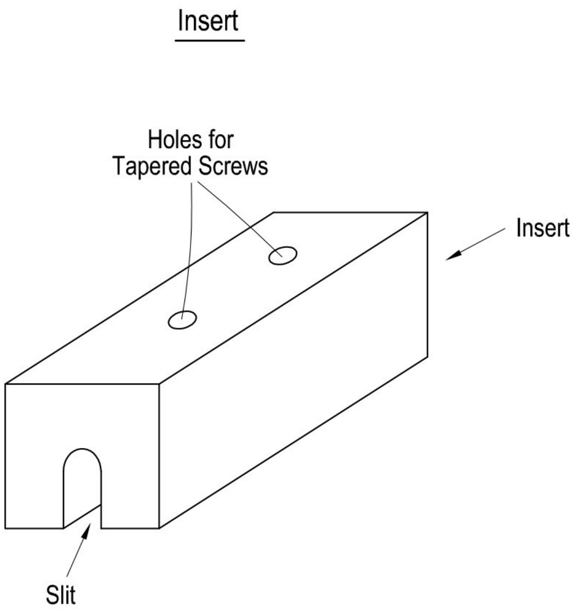

Fig. 3A

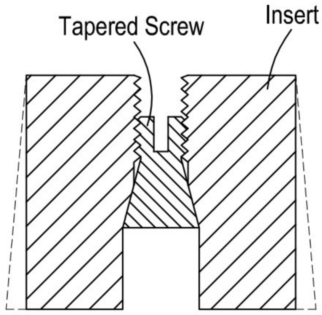

Fig. 3B

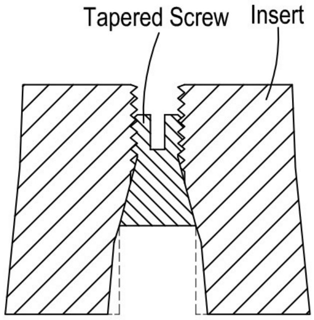

Fig. 3C

Client’s drawings

4/5

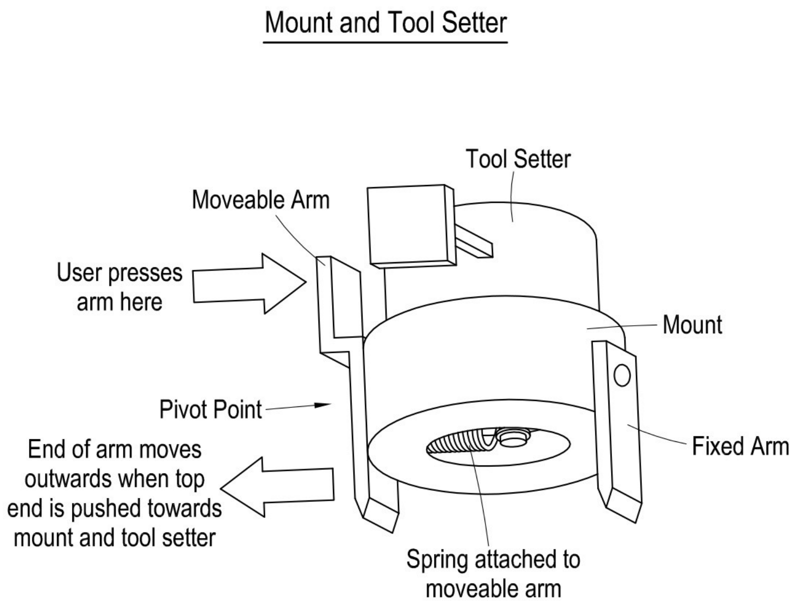

Fig. 4

Client's drawings

5/5

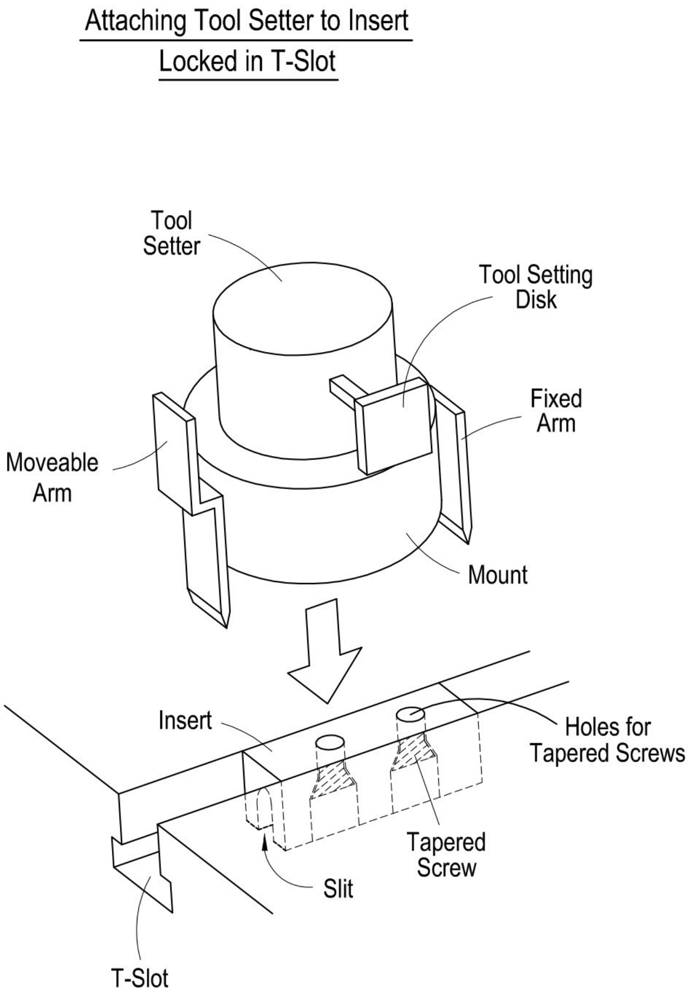

Fig. 5

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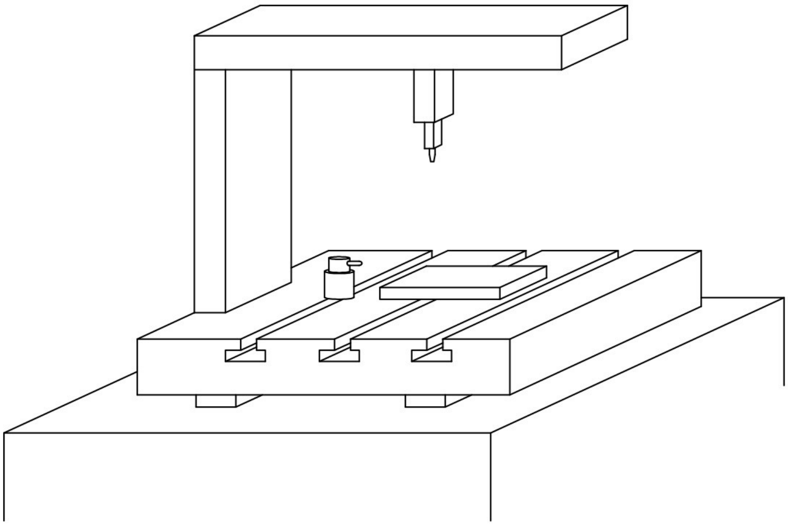

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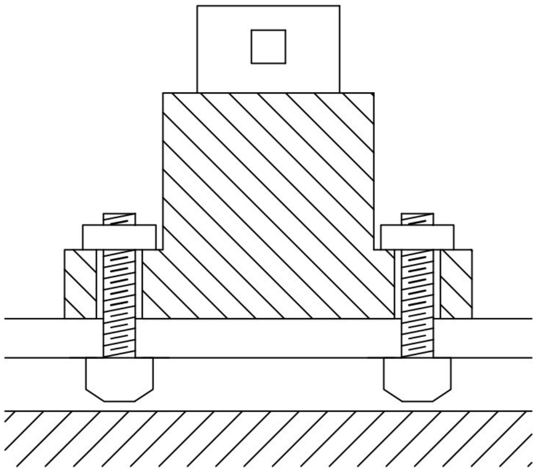

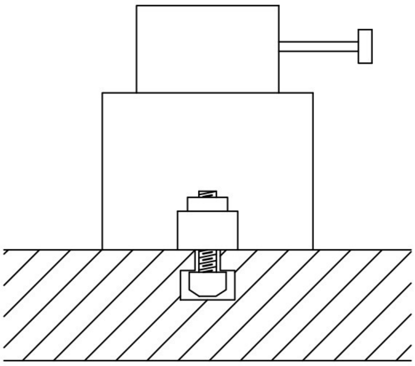

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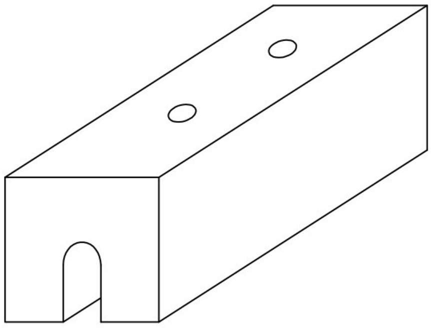

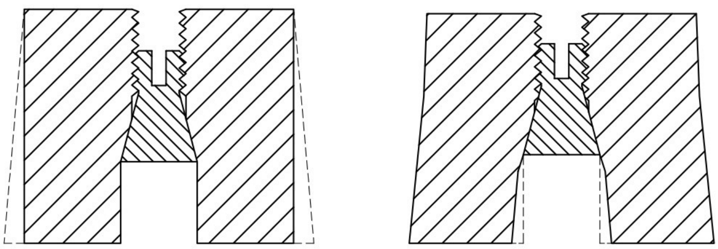

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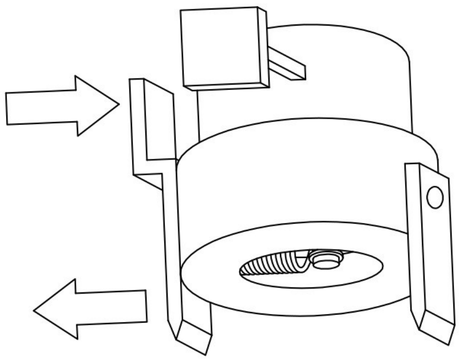

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