

The invention relates to a device for cutting three-dimensional moulded parts made of plastics or the like, the device comprising a mould bottom for holding the moulded parts and a cutting head movable relative to the mould bottom along a cutting track and mounted on a robot arm or the like so as to be rotatable around two axes at right angles to one another, the bearing surface formed by the mould bottom having an interruption along the cutting track (see US-A-4 465 919).

Three-dimensional moulded parts made of plastics, fibre-reinforced material, rubber, composite material, and so on, are used in the most diverse industries and branches of industry, e.g. as lining and dashboard parts in the motor vehicle industry, and after their moulding these parts have to be trimmed to ensure a clean edge true to dimensions. Because of the properties of the materials used and the three-dimensional shape of the required cutting tracks, this trimming of the moulded parts has hitherto caused considerable difficulty. For example, cutting with the knife always had to be carried out manually, this being unsatisfactory for industrial use in view of the related labour intensity and inaccuracy, and automated trimming hitherto made use of water jet or laser cutting. For example US-A-4 465 919 already discloses a cutting device for three-dimensional mouldings wherein a mould bottom receiving the mould parts is mounted on a robot arm and moved past a laser head along a cutting track. To guide the laser beam, however, the mould bottom has to be divided so that the supporting effect precisely in the cutting zone having the parting slot is relatively weak and while it is adequate for the low cutting forces occurring with laser cutting it would be inadequate for the greater cutting forces originating from a knife. In addition, complex beam guidance is frequently inevitable in the case of laser cutting and the high temperatures cause changes of the material at the cut surface while the burning of the material during cutting may also result in gas formation harmful to health.

Only relatively minor cutting forces occur in the case of water jet cutting, and they require no special supporting of the workpiece. With the water jet, therefore, it is possible to separate without additional support a moulding excess projecting freely beyond the mould bottom edge extending along the cutting track, so that the required trimming is

obtained simply by guiding the cutting head along the predetermined cutting track. However, in the case of water jet cutting, a fairly complicated water collection system is required, nozzle wear involves cost and maintenance-intensive operation and last but not least noise nuisance has to be tolerated.

EP-A-319 251 also already discloses a device for trimming flat material, comprising a support table for the material and a cutting unit movable over the support surface of the table and having a cutting head equipped with ultrasonic cutters. An additional support arm is fitted to the cutting head and engages by a perforate end beneath the material for cutting and thus prevents the cutting knife point from penetrating into the hole in the support arm and thus allows proper cutting. However, a cutting device of this kind is suitable only for the special cutting of flexible flat material and not for trimming three-dimensional mouldings of rigid plastic.

The object of the invention, therefore, is to provide a device of the kind described hereinbefore, which ensures rational automatable trimming of three-dimensional mouldings by a mechanical knife cut using relatively simple means.

To this end, according to the invention, the cutting head is equipped with a knife, more particularly a knife vibrating at ultrasonic frequency, and a cut-guiding groove following the cutting track is provided in the mould bottom so as to interrupt the bearing surface. As a result, the entire moulding, together with its excess for cutting away, is supported by the mould bottom, the latter being undivided, because of the cut-guiding groove, and forming the required solid support precisely in the cutting zone, so that the mouldings can be trimmed perfectly with a knife independently of their resiliently flexible material properties or the like, the knife being capable of following any three-dimensional cutting tracks with the robot arm. The cut-guiding groove offers the blade passing through the moulding wall thickness the clearance required for cutting beneath the workpiece, thus rendering possible accurate cutting of the mouldings fully supported as far as the immediate vicinity of the cutting track without damaging the support surface, on the one hand, or the knife, on the other hand.

If the cut-guiding groove has a filling of elastic material, e.g. polyurethane, the moulding is given support in the groove zone as well and excellent cutting is guaranteed even in the case of material properties which per se would be most unfavourable for knife cutting. Despite its supporting action for the moulding, the elastic material enables the knife point to penetrate without adverse effect, protects the knife and ensures a damping action in the cutting zone. Also, this filling can easily be exchanged and its properties can thus be adapted to the tools or mouldings for cutting.

To hold the mouldings it is possible to combine the mould bottom with a mould top so that the moulding placed on the mould bottom can be clamped between the mould bottom and top. The mould top, which can be in the form of a simple hold-down device, does not extend beyond the cutting track as does the mould bottom, but leaves the cutting track zone free at the top for accessibility of the knife. However, it is particularly advantageous if the mould bottom has ducts to which negative pressure can be applied to hold the mouldings, said ducts opening into the region near the cut-guiding groove, since in this way the mouldings are sucked against the mould bottom and held down in the immediate vicinity of the cutting process without excessive expenditure. Advantageously, the ducts are disposed on either side of the guide groove so that not only is the moulding itself, but also the cutting waste, is fixed and a very good hold is obtained during cutting.

The subject matter of the invention is illustrated purely diagrammatically in the drawing by reference to a partially sectional side elevation of a device according to the invention.

In order to be able to cut cleanly and exactly by an automatic knife cut three-dimensional moulded parts F made of plastics, rubber, fibre-reinforced material, composite material or the like, a device 1 is provided which comprises a mould bottom 2 to support the moulding F for trimming. The mould bottom 2 extends by its support surface 3 beyond the cutting track S of the trimming process and thus offers full support even for the excess A remaining as cutting waste from the cutting operation. A cut-guiding groove 4 in the mould bottom 2 follows the cutting track S, so that a cutting knife can pass without damage through the wall

thickness of the moulding F during cutting and engage in the groove. The cut-guiding groove 4 is provided with a filling 5 of elastic material, so that support for the moulding F is obtained even in the cutting track zone without having an adverse effect on the cutting process.

To hold the moulding F, ducts 6 to which negative pressure can be applied are provided in the mould bottom 2 and open out into the region near the cut-guiding groove 4 and suck the moulding F against the support surface 3 to fix it during trimming. To take greater cutting forces, a mould top 7 (shown only in broken lines) can be provided to co-operate with the mould bottom 2, and be pressed down against the latter, and clamp the moulding F fast. This mould top 7 extends only into the area of the cut-guiding groove 4 and leaves the cutting track zone S freely accessible.

For the cutting operation itself, a knife-equipped cutting head 8 is provided, which preferably accommodates a knife 9 vibrating at ultrasonic frequency, to ensure very accurate cut guidance which subjects the mould support system to minimum loading. To be able to follow any three-dimensional cutting configuration the cutting head 8 is attached to a three-axis-controlled robot arm 10 which is rotatably adjustable about two axes I, II at right angles to one another, so that a five-axis-controlled automatic cutter is obtained overall, which allows perfect fully automatic cutting of the mouldings F, which are accordingly supported fully and throughout.



C L A I M S

1. A device (1) for cutting three-dimensional moulded parts (F) made of plastics or the like, the device comprising a mould bottom (2) for holding the moulded parts (F) and a cutting head (7) movable relative to the mould bottom (2) along a cutting track (S) and mounted on a robot arm (10) or the like so as to be rotatable around two axes (I, II) at right angles to one another, the bearing surface (3) formed by the mould bottom (2) having an interruption along the cutting track (S), characterised in that the cutting head (8) is equipped with a knife, more particularly a knife (9) vibrating at ultrasonic frequency, and a cut-guiding groove (4) following the cutting track (S) is provided in the mould bottom (2) so as to interrupt the bearing surface (3).

2. A device according to claim 1, characterised in that the cut-guiding groove (7) has a filling (5) of resilient material, e.g. polyurethane.

3. A device according to claim 1 or 2, characterised in that the mould bottom (2) has ducts (6) which can be subjected to negative pressure for holding the moulded parts (F) and open into the region near the cut-guiding groove (4).