[0018] **FIG. 7** is a flow chart showing a related art method of making a tool path;

[0019] **FIG. 8** is a schematic diagram showing reference lines of a processing region;

[0020] **FIG. 9** is a schematic diagram showing a tool path with reference lines formed of straight lines;

[0021] **FIG. 10** is a schematic diagram showing a tool path with reference lines formed of curves;

[0022] **FIG. 11** is a schematic diagram pointing out problems encountered in a related art method of this kind.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] The modes of embodiment of the present invention will now be described on the basis of the drawings. **FIG. 1** is a flow chart showing a method of making a tool path for a machine tool using a CAM. First, in steps **S1** to **S5**, a shape to which a work is to be processed is inputted, and then the processing conditions, a processing region being designated on the surface to be processed, in the same manner as in a related art method of this kind. Reference lines are designated on both edges of the processing region, and a tool path in the processing region is calculated on the basis of the reference lines.

[0024] Next, in a step **S6**, a tool escaping or tool approaching expansion region is added to the processing region. When the number of the processing region in this embodiment is one, a tool escaping expansion region **1** is added to a terminal end in the picking direction of the processing region, as shown in **FIG. 2**, or a tool approaching expansion region **2** is added to a starting end in the picking direction of the processing region, as shown in **FIG. 3**. One expansion region, which is to be added out of these two expansion regions, is determined in accordance with the shape to which the work is to be formed.

[0025] When the surface to be processed is divided into parts with a plurality of processing regions designated, a tool escaping expansion region **1** is added as shown in **FIG. 4** to a terminal end in the picking direction of a processing region precedingly out of two adjacent processing regions. Then a tool approaching expansion region **2** is added to a starting end in the picking direction of a processing region. In this case, in a processing region positioned intermediately (processing region **2** in **FIG. 4**) has a tool escaping expansion region **1** and a tool approaching expansion region **2** added to both ends thereof, as shown in **FIG. 5**.

[0026] These expansion regions **1**, **2** are tangential curved surfaces contacting the surface to be processed, and including boundary lines between the expansion regions and a processing region, i.e. reference lines. In order to designate the expansion regions **1**, **2**, an expansion amount E of the tangential curved surface and radii (i.e. tool approaching and escaping radii R), which are defined in **FIG. 6**, are included in the conditions and inputted in the above-mentioned step S2. It is preferable that the tool approaching and escaping radii be set higher ($R \geqq E$) than the expansion amount so that the expansion regions **1**, **2** smoothly separate from the surface to be processed.

[0027] Next, in a step S7, tool paths included in the added expansion regions **1**, **2** are calculated on the basis of the reference lines. In this embodiment, the tool paths are calculated so that an amount (h) of separation thereof from the surface to be processed increases as the tool paths get away from the processing regions. To be concrete, provisional tool paths are calculated by making the calculation identical with that made to determine the processing region. Next, the tool paths are calculated by parallel transferring the provisional tool paths in the direction (positive direction of a Z-axis) in which the tool paths get away from the surface to be processed by the following h every time the tool paths get away by a predetermined distance (P) from the reference lines of the processing region.

$$h=R-\{R^2-(nP)^2\}^{1/2}$$

[0028] wherein n is an arbitrary integer ($0<n \leqq N$). The amount E of expansion is ($E=NP$).

[0029] Next, in a step **S8**, the tool paths in the expansion regions **1**, **2** are added to that of the processing region, and data on such a group of tool paths are outputted. When there is a plurality of processing regions, it is preferable that a small range of lap portion be designated in a position adjacent to each processing region, as shown in **FIG. 4**. When such lap portions are designated, the expansion regions get away smoothly from the surface to be processed in a position beyond the reference lines of the processing regions. Therefore, a boundary portion between adjacent regions can be processed smoothly without causing a difference in level to occur.

[0030] The present invention is not limited to the above-described modes of embodiment. The invention can also be practiced by suitably changing the shape and construction of each part within the scope not departing from the gist of the invention.

[0031] (1) The reference lines are designated by setting the same lines in agreement with a centerline of a processing region.

[0032] (2) The above-mentioned method is applied to such a cylindrical surface as is shown in **FIG. 11** and a surface to be processed which is formed of some other curved surface.

[0033] (3) The above-mentioned method is applied to a contour line processing operation.

[0034] (4) The method is applied to two adjacent processing regions the picking directions of which are different from each other.

[0035] (5) A surface to be processed is divided into parts, and a plurality of processing regions is designated automatically by calculation in the midst of the formation of a processing path.

[0036] According to the invention described in claim 1, a tool path smoothly approaches a surface being processed in a tool approaching expansion region, while the tool path smoothly gets away from the surface being processed in a tool escaping expansion region. Therefore, the invention has an effect of making a difference in level inconspicuous on the starting end or terminal end of the processed region.

[0037] According to the invention describe in claim 2 above, a tool path smoothly approaches or gets away from a surface being processed in a tool approaching or tool escaping expansion region in a boundary portion of each of