

web. This leads to wafers which have relatively pronounced deviations from a desired perfect plane-parallelism of their front and back sides, particularly in the cut-in region. Such a deviation, in the same direction, of the front and back sides from planarity in the cut-in region may be referred to as a "cut-in wave".

Known cut-in beams are unsuitable for solving the problem of long-wavelength deviations of the front and back sides of the wafers obtained by cutting the ingot from the desired plane-parallelism with one another in the particularly critical cut-in region.

Irregular cut-in can lead to planarity deviations, not in the same direction, of the respective front and back sides of the cut wafers. In particular, under certain circumstances the wafers are thinner in the cut-in region than at other positions. This form of nonplanarity in the cut-in region of a wafer may be referred to as a "cut-in wedge".

Object of the Invention

~~The object~~ Embodiments of the present invention ~~is seek~~ to provide a method for simultaneously cutting a multiplicity of wafers from a cylindrical workpiece, by which a high degree of planarity and parallelism of their respective front and back sides in the region of the cut-in is imparted to the wafers.

Solution

~~The object is achieved by~~ According to an aspect, a method for simultaneously cutting a multiplicity of wafers from a cylindrical workpiece having an axis and a notch applied parallel to the axis in the lateral

surface of the workpiece, comprising the application of a cut-in beam on the workpiece, the cut-in beam being fitted from a front side of the cut-in beam to a rear side with a form fit with a head / first end in the notch, and protruding out of the notch with a foot / second end; holding of the workpiece with its axis parallel to the axes of cylindrical wire guide rollers of a wire saw by means of a feed device of the wire saw; movement of the cut-in beam and of the workpiece by means of the feed device in a feed direction perpendicularly through a planar wire web consisting of sections, arranged parallel to one another and perpendicular to the axes of the wire guide rollers, of a wire which is guided multiple times ~~in a spiral~~ around the wire guide rollers by means of grooves in the wire guide rollers, ~~the cut-in beam being moved first with the foot end, and the workpiece first with the notch, against the wire web;~~ and movement of the wire sections in the longitudinal wire direction by rotation of the wire guide rollers in the ~~same sense with the same circumferential speed in the presence of~~ abrasives acting as a grinding agent.

The cut-in beam preferably has the shape of a circular cylinder or of a body with a length, height and width, the length being greater than the height and the height being equal to or greater than the width.

The length of the cut-in beam extends from a front side to a rear side, the height of the cut-in beam corresponds to the greatest vertical distance between the head end and the foot end, and the width of the cut-in beam corresponds to the greatest extent of the cut-in beam in the direction of the wire sections. The width of the cut-in beam is preferably equal to the width of the notch on the circumference of the workpiece.

Patent Claims:

1. A method for simultaneously cutting a multiplicity of wafers
5 from a cylindrical workpiece having an axis and a notch applied
parallel to the axis in the lateral surface of the workpiece,
comprising
the application of a cut-in beam on the workpiece, the cut-in
beam being fitted from a front side to a rear side with a form
10 fit with a head end in the notch, and protruding out of the
notch with a foot end;
holding of the workpiece with its axis parallel to the axes of
cylindrical wire guide rollers of a wire saw by means of a feed
device of the wire saw;
15 movement of the cut-in beam and of the workpiece by means of
the feed device in a feed direction perpendicularly through a
planar wire web consisting of sections, arranged parallel to
one another and perpendicular to the axes of the wire guide
rollers, of a wire which is guided multiple times in a spiral
20 around the wire guide rollers by means of grooves in the wire
guide rollers, the cut-in beam being moved first with the foot
end, and the workpiece first with the notch, against the wire
web; and
movement of the wire sections in the longitudinal wire
25 direction by rotation of the wire guide rollers in the same
sense with the same circumferential speed in the presence of
abrasives acting as a grinding agent.
2. The method as claimed in claim 1, comprising movement of the
30 workpiece through the wire web in such a way that, during this,
the wire sections exhibit constant bending in the feed
direction.

3. The method as claimed in claim 1 or 2, comprising movement of the cut-in beam foot end, protruding out of the notch, through the wire web in such a way that, during this, the wire sections exhibit variable bending in the feed direction.

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4. The method as claimed in claim 3, comprising movement of the cut-in beam foot end, protruding out of the notch, through the wire web in such a way that, during this, the bending of the wire sections assumes a maximum which is no longer achieved in the further course of the cutting process.

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5. The method as claimed in one of claims 1 to 4, comprising, when applying the cut-in beam on the workpiece, adhesive bonding of the head end of the cut-in beam into the notch with an adhesive.

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6. The method as claimed in one of claims 1 to 5, comprising the provision of a cut-in beam with a height, between the head end and the foot end, which is constant between the front side and the rear side.

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7. The method as claimed in one of claims 1 to 6, comprising the provision of a cut-in beam in the shape of a circular cylinder.

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8. The method as claimed in one of claims 1 to 6, comprising the provision of a cut-in beam in which the shape of the cross section of the foot end varies between the front side and the rear side in the feed direction, in such a way that the wire sections cut into the cut-in beam with decreasing engagement lengths.

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9. The method as claimed in claim 8, comprising the provision of a cut-in beam in which the shape of the cross section of the foot end becomes increasingly wedge-shaped between the front side and the rear side in the feed direction.

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10. The method as claimed in one of claims 1 to 5, comprising the provision of a cut-in beam having a height, between the head end and the foot end, which decreases between the front side and the rear side, so that the wire sections cut
10 commensurately later into the cut-in beam the longer the wire path between the wire sections and a start of the wire web.

11. The method as claimed in one of claims 1 to 6 and 8 to 10, comprising the conduct of a test cut during which the cut-in
15 beam is obviated, and determination of a maximum depth of cut-in waves in the wafers of the test cut; and provision of the cut-in beam with a height of the cut-in beam foot end protruding from the notch which is equal to or greater than the maximum depth determined.

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12. The method as claimed in one of claims 1 to 11, comprising the provision of grooves on the cut-in beam side which lies opposite the wire web, the grooves being arranged
perpendicularly over the wire sections.

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13. The method as claimed in claim 12, wherein the grooves are arranged perpendicularly over the wire sections after a position displacement of the wire sections in the direction of the axes of the wire guide rollers, caused by thermal expansion
30 at the operating temperature, has taken place.

Patent Claims:

1. A method for simultaneously cutting a multiplicity of wafers from a cylindrical workpiece having an axis and a notch applied parallel to the axis in the lateral surface of the workpiece,
5 comprising
the application of a cut-in beam on the workpiece, the cut-in beam being fitted from a front side of the cut-in beam to a rear side with a form fit with a first end in the notch, and
10 protruding out of the notch with a second end;
holding of the workpiece with its axis parallel to the axes of cylindrical wire guide rollers of a wire saw by means of a feed device of the wire saw;
movement of the cut-in beam and of the workpiece by means of the
15 feed device in a feed direction perpendicularly through a planar wire web consisting of sections, arranged parallel to one another and perpendicular to the axes of the wire guide rollers, of a wire which is guided multiple times around the wire guide rollers by means of grooves in the wire guide rollers; and
20 movement of the wire sections in the longitudinal wire direction by rotation of the wire guide rollers in the presence of abrasives acting as a grinding agent.
2. The method as claimed in claim 1, comprising movement of the
25 workpiece through the wire web in such a way that, during this, the wire sections exhibit constant bending in the feed direction.
3. The method as claimed in claim 1 or 2, comprising movement of
30 the cut-in beam second end, protruding out of the notch, through

the wire web in such a way that, during this, the wire sections exhibit variable bending in the feed direction.

4. The method as claimed in claim 3, comprising movement of the cut-in beam second end, protruding out of the notch, through the wire web in such a way that, during this, the bending of the wire sections assumes a maximum which is no longer achieved in the further course of the cutting process.
5. The method as claimed in one of claims 1 to 4, comprising, when applying the cut-in beam on the workpiece, adhesive bonding of the first end of the cut-in beam into the notch with an adhesive.
6. The method as claimed in one of claims 1 to 5, comprising the provision of a cut-in beam with a height, between the first end and the second end, which is constant between the front side and the rear side.
7. The method as claimed in one of claims 1 to 6, comprising the provision of a cut-in beam in the shape of a circular cylinder.
8. The method as claimed in one of claims 1 to 6, comprising the provision of a cut-in beam in which the shape of the cross section of the second end varies between the front side and the rear side in the feed direction, in such a way that the wire sections cut into the cut-in beam with decreasing engagement lengths of the wire sections.
9. The method as claimed in claim 8, comprising the provision of a cut-in beam in which the shape of the cross section of the

second end becomes increasingly wedge-shaped between the front side and the rear side in the feed direction.

10. The method as claimed in one of claims 1 to 5, comprising
5 the provision of a cut-in beam having a height, between the first end and the second end.

11. The method as claimed in one of claims 1 to 6 and 8 to 10,
comprising the conduct of a test cut during which the cut-in
10 beam is obviated, and determination of a maximum depth of cut-in waves in the wafers of the test cut; and provision of the cut-in beam with a height of the cut-in beam second end protruding from the notch which is equal to or greater than the maximum depth determined.

15 12. The method as claimed in one of claims 1 to 11, comprising the provision of grooves on the cut-in beam side which lies opposite the wire web, the grooves being arranged over the wire sections.

20 13. The method as claimed in claim 12, wherein the grooves are arranged over the wire sections after a position displacement of the wire sections in the direction of the axes of the wire guide rollers, caused by thermal expansion, has taken place.