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CUTTING MACHINE AND METHOD OF CUTTING

Technical Field

This invention relates to a cutting machine and a method of cutting and refers particularly, though not exclusively, to a cutting machine for cutting a blank such as, for example, an ingot of a semiconductor or other material, and a method of cutting such a blank.

Background

The cutting of blanks such as, for example, ingots, of semiconductor material is normally performed by using a large number of parallel fine wires to perform the cutting action in the presence of a slurry that is sprayed on to the wires as they commence the cutting action. A spray of air is used immediately after the cutting action in an attempt to clean the wires. The ingot may be, for example, of silicon and the cutting may be to produce individual wafers for fabrication of semiconductors.

Although diamond wires are preferred due to their superior cutting action, they cannot normally be used as they clog with the semiconductor material. That will often require them to be regularly replaced, thereby making their use very expensive.

Furthermore, the use of normal cutting wires can slow the cutting speed, and result in cuts that are inconsistent thereby providing less useful results. It also results in lower yield, more waste and low throughput. This may mean, for example, fewer useable wafers from a given ingot, and inconsistent thickness of the wafers. Wafers that are uneven in thickness may result in reduced or uneven quality of semiconductors.

Summary

According to an exemplary aspect there is provided a machine to be used in the cutting of a blank into individual items, the machine comprising a wire feeder and a wire receiver, the

wire feeder and the wire receiver being generally parallel and spaced apart; the wire feeder being for supplying a plurality of parallel cutting wires to a cutting station and the wire receiver being for receiving the plurality of cutting wires from the cutting station; the cutting station comprising at least one tank for receiving therein a solution such that the cutting of the blank takes place in the solution.

According to another exemplary aspect there is provided a machine to be used in the cutting of a blank into individual items, the machine comprising a wire feeder and a wire receiver, the wire feeder and the wire receiver being generally parallel and spaced apart; the wire feeder being for supplying a plurality of parallel cutting wires to a cutting station and the wire receiver being for receiving the plurality of cutting wires from the cutting station; the cutting station comprising at least one tank for receiving therein a solution, the at least one tank having two spaced apart and generally parallel side walls, there being two spaced apart and generally parallel end walls joining ends of the side walls; each of the plurality of wires passing through an opening in the side walls in a non-fluid-tight manner such that the solution can pass through the openings during operation of the machine.

According to a further exemplary aspect, there is provided a machine to be used in the cutting of a blank into individual items, the machine comprising a wire feeder and a wire receiver, the wire feeder and the wire receiver being generally parallel and spaced apart; the wire feeder being for supplying a plurality of parallel cutting wires to a cutting station and the wire receiver being for receiving the plurality of cutting wires from the cutting station; the cutting station comprising at least one tank for receiving therein a solution; all cutting of the blank taking place in the solution, the solution having a laminar flow in the at least one tank.

According to a yet further exemplary aspect there is provided a machine to be used in the cutting of a blank into individual items, the machine comprising a wire feeder and a wire

receiver, the wire feeder and the wire receiver being generally parallel and spaced apart; the wire feeder being for supplying a plurality of parallel cutting wires to a cutting station and the wire receiver being for receiving the plurality of cutting wires from the cutting station; the cutting station comprising at least one tank for receiving therein a solution; and a carrier for holding the blank during the cutting process, the carrier being receivable in a support assembly comprising a plurality of rollers on which the carrier is able to move, the support assembly further comprising a locking mechanism configured to lock the carrier relative to the support assembly when the carrier is correctly placed relative to the cutting station.

According to yet another exemplary aspect there is provided a method to cut a blank into individual items, the method comprising:

(a) attaching the blank to a bottom of a carrier;

(b) engaging the carrier with a support assembly;

(c) moving the carrier with the blank longitudinally relative to the support assembly until the blank is directly above a cutting station;

(d) lowering the support assembly with the carrier and the blank until a bottom of the blank contacts a plurality of cutting wires and is below a top of a tank containing a solution; and

(e) cutting the blank into the individual items while at least a relevant portion of the wires is in the solution in the tank.

For one or more of the above exemplary aspects the machine may also be able to operate in a reverse mode when the wire feeder is the wire receiver and the wire receiver is the wire feeder. Each of the plurality of wires may be a diamond wire. The wires may be configured to be in the solution at all times during the cutting process. Alternatively, the wires may be configured to not be in the solution when contacted by the blank, the pressure of the blank forcing a relevant portion of the wires into the solution for the cutting to take place in the solution; the relevant portion being for at least the full width of the blank.

The at least one tank may have two spaced apart and generally parallel side walls, there being two spaced apart and generally parallel end walls joining ends of the side walls; each of the plurality of wires may pass through an opening in the side walls in a non-fluid-tight manner such that the solution can pass through the openings during operation of the machine. Each of the side walls may be double walled and may comprise an inner side wall and an outer side wall parallel to and spaced from the inner side wall to form a side wall gap therebetween; the flow of the solution into the at least one tank being via the side wall gap and over the top edge of the inner side wall. Each of the end walls may be double walled and may comprise an inner end wall and an outer end wall parallel to and spaced from the inner end wall to form an end wall gap therebetween; a partial flow of the solution out of the tank being over the upper edge of the inner end wall and via the end wall gap. A rate of supply of the solution may be equal to a sum of the solution outflow through the openings and over the upper edges of the end wall. The opening is selected from: one opening for each wire, a plurality of openings each being for a group of wires, and one opening in each of the side walls with all wires passing through that one opening. The one opening in each of the side walls may be through each of the inner side walls and the outer side walls. The openings may be below the top edge of the inner side wall. The machine may be configured such that, in use, the solution has a laminar flow in the at least one tank. The top edge of the inner side wall may be serrated or scalloped. The inner side wall may be of a lower height than the outer side wall. The inner end wall may be of a lower height than the outer end wall. The upper edge of the inner end wall may be serrated or scalloped. The machine may further comprise a carrier for holding the blank during the cutting process. The carrier may be receivable in a support assembly comprising a plurality of rollers on which the carrier is able to move. The support assembly may further comprise a locking mechanism configured to lock the carrier relative to the support assembly when the carrier is correctly placed relative to the cutting station. The carrier may be substantially T-shaped and may have a flange with stepped side walls. The carrier may be supported by the support assembly and may be able to move longitudinally relative to the support assembly

and may be able to have a small lateral relative movement relative to the support assembly. The support assembly may have side walls that are correspondingly-shaped to the side walls of the carrier. The rollers may project inwardly from the side walls of the support assembly at a lower end thereof. The rollers may engage under lowermost surfaces of the stepped side walls of the carrier. The locking mechanism may comprise a downwardly-angled end configured to engage under a correspondingly-angled upper portion of the side walls of the carrier to lift the lower surface of the side walls of the carrier off the rollers and to move the carrier laterally relative to the support assembly such that the opposite side wall of the carrier locks against its corresponding side wall of the support assembly. The blank may be an ingot of a semiconductor or other material.

For the yet another exemplary aspect, at (d) the wires may be in the solution. Alternatively, at (d) the wires may be slightly above the solution and the support assembly continues to move downwardly at a controlled rate until the wires deform slightly under the applied pressure of the blanks such that the wires are in the solution at least for the full width of the blanks. All cutting of the blank by the wires may take place in the solution. The relevant portion of the wires may be in the solution during all stages of the cutting action. The relevant portion may be that portion of the wires in a cutting station and being at least for the full width of the blank. The wires may be able to operate in a forwards and a reverse mode. The wires may be diamond wires. The longitudinal movement in (c) may be a rolling movement. The blank may be an ingot of a semiconductor or other material.

Brief Description of the Drawings

In order that the invention may be fully understood and readily put into practical effect there shall now be described by way of non-limitative example only exemplary embodiments, the description being with reference to the accompanying illustrative drawings.

In the drawings:

Figure 1 is a front perspective view from above of an exemplary embodiment;

Figure 2 is a front view of the exemplary embodiment of Figure 1;

Figure 3 is a front view of the carrier and support assembly of the exemplary embodiment of Figures 1 and 2 and when in a first state;

Figure 4 is a view corresponding to Figure 3 when in a second state;

Figure 5 is a view corresponding to Figure 1 on an enlarged scale and in partial breakaway;

Figure 6 is a view corresponding to Figure 5 in further breakaway;

Figure 7 is a longitudinal cross-sectional view of the tank of Figures 1 to 6;

Figure 8 is a lateral cross-sectional view of the tank of Figures 1 to 7;

Figure 9 is a front view of the cutting machine at a first stage of the cutting process;

Figure 10 is a front view of the cutting machine at a second stage of the cutting process;

Figure 11 is a front view of the cutting machine at a third stage of the cutting process; and

Figure 12 is a front view of the cutting machine at a fourth stage of the cutting process.

Detailed Description of the Exemplary Embodiments

To first refer to Figures 1 and 2, there is shown a cutting machine 10 that has a carrier 12 for one or more blanks 14 (two as shown) of a material to be cut into a number of separate components. As shown the blanks 14 are of a silicon material to be cut into separate wafers for use in semiconductor fabrication. However, the invention is not limited to that use. The blank 14 is attached to the carrier 12 by an epoxy, adhesive, or the like, in a known manner. It is attached to the bottom surface 15 of the carrier 12.

The carrier 12 is mounted for longitudinal movement relative to a support assembly 16 until the blank is correctly located above a plurality of cutting wires 22 that form a wire web. The wires 22 are supplied to a cutting station 17 by a wire feeder 18 and are received by a wire receiver 20. As shown, both the wire feeder 18 and the wire receiver 20 are cylindrical drums. However, the invention is not so limited. Preferably, the cylindrical drums 18,20 are

of sufficient diameter that only the two drums 18, 20 are required and no idler drum is required. This will enable the return path for the wires 22 to be substantially parallel to the supply path for the wires 22.

The machine may operate in a forwards mode where the wires 22 are supplied to the cutting station 17 by the wire feeder 18 and are received from the cutting station by the wire receiver 20; and in a reverse mode where the wires 22 are supplied to the cutting station 17 by the wire receiver 20 (now acting as a wire feeder) and are received from the cutting station 17 by the wire feeder 18 (now acting as a wire receiver).

The wire feeder 18 and the wire receiver 20 may be of known construction and operation. They may be in accordance with the wire feeding/receiving system of the wire saw as available from Meyer Burger Technology AG of Grabenstrasse 25, 6340 Baar, Switzerland.

The cutting station 17 is at the upper end of a tank 24 configured to hold a solution of a cutting liquid of any suitable and known form, including water. The machine has a solution supply and filtration system (not shown) of known construction.

An outer housing 26 may be used to house the machine 10 components.

For the sake of clarity only a small number of wires 22 are shown. There may be any suitable number of wires 22 with the number being determined by the number and thickness of the wafers required. In use there may be in excess of 1,000 wires 22. The wires 22 may be of any suitable, known form including, but not limited to, diamond wire.

As shown in Figures 3 and 4, the carrier 12 is approximately T-shaped and has a flange 28 with stepped side walls 30. The carrier 12 is supported by the support assembly 16 and is able to move longitudinally relative to the support assembly 16. A small lateral relative

movement is also enabled. The support assembly 16 has side walls 36 that are correspondingly-shaped to the side walls 30. To assist the longitudinal movement of the carrier 12 relative to the support assembly 16, the side walls 36 of the support assembly 16 have projecting inwardly therefrom at a lower end thereof a plurality of opposed rollers 34 that engage under the lowermost surfaces 32 of the stepped side walls 30 of the carrier 12 (Figure 3) so that the carrier 12 can roll on the rollers 34 when moving longitudinally relative to the support assembly 16. This will reduce the operator force required for such a movement compared to the sliding relative movement that has previously been required. To prevent unwanted movement of the carrier 12 such as during the cutting operation, the support assembly 16 has at least one locking mechanism 37 that, as shown, is an hydraulic ram 38. When the hydraulic ram 38 is operated its downwardly-angled end 39 engages under a correspondingly-angled upper portion 40 of the side walls 30 of the carrier 12 to lift the lower surface 32 off the rollers 34 and moves the carrier 12 laterally relative to the support assembly 16 such that the opposite side wall 30a of the carrier jams against its corresponding side wall 36a of the support assembly 16 (Figure 4). For this reason, it is preferred that the locking mechanisms 37 are all on one side 36b of the support assembly 16.

Figures 5 to 8 show the details of the tank 24 in more detail. The tank 24 is generally cuboid with a base 42, parallel side walls 44 and parallel end walls 46 joining the ends of the side walls 44. The side walls 44 are each double walled and have an inner side wall 44a and an outer side wall 44b forming a side wall gap 44c therebetween. The inner side wall 44a is of a lower height than the outer side wall 44b. The inner side wall 44a has a top edge 48a that is serrated or scalloped along its length. The outer side wall 44b has a top edge 48b that is plain or flat. The end walls 46 are each double walled and have an inner end wall 46a and an outer end wall 46b forming an end wall gap 46c therebetween. The inner end wall 46a is of a lower height than the outer end wall 46b. The inner end wall 46a has an upper edge 50a that is serrated or scalloped along its length. The outer end wall

46b has an upper edge 50b that is also serrated or scalloped. It is preferred that the height of the inner end wall 46a is less than the height of the inner side wall 44a such that the top edge 48a is above the upper edge 50a. During operation, the solution level in the tank 24 will be defined by the height of the upper edge 50a.

Alternatively, the side walls 44may be single walled for the lower portion, and double walled for the upper portion.

A solution inlet 52 is provided for each side wall gap 44c adjacent the top of the side wall gap 44c so that the solution can be input into the side wall gaps 44c. The solution will fill the side wall gaps 44c and flow over the top edge 48a of the inner side walls 44a. The serrated or scalloped top 48a assists in providing a laminar flow of the solution into and within the tank 24. When the tank 24 is filled, the solution will flow over the upper edges 50a and into the end wall gaps 46c. The serrated upper edge 50a will assist in providing a laminar flow of the solution out of, and also within, the tank 24.

A solution outlet 54 is provided through the outer end wall 46b and adjacent the bottom of each end wall gap 46c to enable the solution flowing over the upper edge 50a to be recovered, filtered and recycled in a known manner. Alternatively, the solution that passes over the upper edge 50a may be separately removed from the machine 10 and the outlets 54 may be for removing solution directly from the lower regions of the tank 24. This may aid in the removal of fine debris from the cutting action.

A removable basket or plate 56 may be fitted in the tank 24 for collecting debris of the cutting action. The basket or plate 56 may have a large number of small holes 58.

Each of the wires 22 passes through an opening 60 in each of the side walls 44a and 44b. The opening 60 in the inner side wall 44a is located below the top edge 48a and, preferably,

is below the upper edge 50a of the inner end walls 46a so that the wires 22 are in the solution at all times during the cutting process. The opening 60 is such that, during operation, the solution may be able to flow through the opening 60 and out of the tank 24. This is acceptable provided the rate of supply of the solution through the solution inlets 52 is equal to the sum of the solution outflow through: the openings 60 and over the upper edges 50a and/or through outlets 54. As the solution will flow over the upper edges 50a only when the tank 24 is full, this will allow the tank 24 to fill. The solution outlets 54 are for removing any solution that passes over the upper edges 50a and/or for directly removing solution from the tank 24. There may be an opening 60 for each wire 22, a plurality of openings 60 each being for a group of wires 22, or one opening 60 in each of the inner side walls 44a and outer side walls 44b, all wires 22 passing through that one opening 60. If the side walls are single walled at their lower portion and double walled at their upper portion, the openings 60 may be in the single walled portion, or may be in the double-walled portion.

Figures 9 to 11 illustrate the process. After the blank 14 (in this case two ingots of a silicon material) are secured to the bottom of the carrier 12, the carrier 12 is engaged with the support assembly 16 and moved longitudinally relative to the support assembly 16 until the blank 14 is directly above the cutting station 17. The locking mechanism 37 is then engaged. The wires are then activated and move from the wire feeder 18 to the wire receiver 20 when in the forwards mode, and the reverse when in reverse mode (Figure 9). The support assembly 16 with the carrier 12 and the blank 14 are lowered until the bottom of the blanks 14 contact each of the wires 22 (Figure 10). At this stage the wires may be in the solution, or may be slightly above the solution. The support assembly 16 continues to move downwardly at a controlled rate until the wires deform slightly under the applied pressure of the blanks 14. If the wires were out of the solution at the initial contact between the blanks 14 and the wires 22, the wires 22 will now be in the solution at least for the full width of the blanks 14 (Figure 11). The downwards movement of the support assembly 16 with the carrier 12 and the blanks 14 continues at a controlled rate that matches the cutting

speed of the wires 22 until the blanks 14 are cut completely through (Figure 12). All cutting of the blanks 14 by the wires 22 takes place in the solution. The relevant portion of the wires 22 (that portion in the cutting station and being at least for the full width of the blanks) is in the solution during all stages of the cutting action. Due to the epoxy or adhesive layer 13, the separated wafers will remain attached to the carrier 12. The support assembly 16 is then moved upwardly thus removing the separated wafers and the carrier 12 from the tank 24. The separated wafers can then be removed in the normal manner.

Whilst the foregoing description has described exemplary embodiments, it will be understood by those skilled in the technology concerned that many variations in details of design, construction and/or operation may be made without departing from the present invention.

The Claims

1. A machine to be used in the cutting of a blank into individual items, the machine comprising a wire feeder and a wire receiver, the wire feeder and the wire receiver being generally parallel and spaced apart; the wire feeder being for supplying a plurality of parallel cutting wires to a cutting station and the wire receiver being for receiving the plurality of cutting wires from the cutting station; the cutting station comprising at least one tank for receiving therein a solution such that the cutting of the blank takes place in the solution.

2. A machine as claimed in claim 1, wherein the machine is also able to operate in a reverse mode when the wire feeder is the wire receiver and the wire receiver is the wire feeder.

3. A machine as claimed in claim 1 or claim 2, wherein each of the plurality of wires is a diamond wire.

4. A machine as claimed in any one of claims 1 to 3, wherein the wires are configured to be in the solution at all times during the cutting process.

5. A machine as claimed in any one of claims 1 to 3, wherein the wires are configured to not be in the solution when contacted by the blank, the pressure of the blank forcing a relevant portion of the wires into the solution for the cutting to take place in the solution; the relevant portion being for at least the full width of the blank.

6. A machine as claimed in any one of claims 1 to 5, wherein the at least one tank has two spaced apart and generally parallel side walls, there being two spaced apart and generally parallel end walls joining ends of the side walls; each of the plurality of wires passing through an opening in the side walls in a non-fluid-tight manner such that the solution can pass through the openings during operation of the machine.

7. A machine as claimed in claim 6, where each of the side walls is double walled and comprises an inner side wall and an outer side wall parallel to and spaced

from the inner side wall to form a side wall gap therebetween; the flow of the solution into the at least one tank being via the side wall gap and over the top edge of the inner side wall.

8. A machine as claimed in claim 6 or claim 7, where each of the end walls is double walled and comprises an inner end wall and an outer end wall parallel to and spaced from the inner end wall to form an end wall gap therebetween; a partial flow of the solution out of the tank being over the upper edge of the inner end wall and via the end wall gap.

9. A machine as claimed in claim 8, wherein a rate of supply of the solution is equal to a sum of the solution outflow through the openings and over the upper edges of the end wall.

10. A machine as claimed in any one of claims 7 to 9, wherein the opening is selected from the group consisting of: one opening for each wire, a plurality of openings each being for a group of wires, and one opening in each of the side walls with all wires passing through that one opening.

11. A machine as claimed in claim 10, wherein the one opening in each of the side walls is through each of the inner side walls and the outer side walls.

12. A machine as claimed in anyone of claims 7 to 11, wherein the openings are below the top edge of the inner side wall.

13. A machine as claimed in any one of claims 1 to 12, wherein the machine is configured such that, in use, the solution has a laminar flow in the at least one tank.

14. A machine as claimed in claim 13, wherein the top edge of the inner side wall is serrated or scalloped.

15. A machine as claimed in claim 13 or claim 14, wherein the inner side wall is of a lower height than the outer side wall.

16. A machine as claimed in any one of claims 13 to 15, wherein the inner end wall is of a lower height than the outer end wall.

17. A machine as claimed in any one of claims 13 to 16, wherein the upper edge of the inner end wall is serrated or scalloped.

18. A machine as claimed in any one of claims 1 to 17 further comprising a carrier for holding the blank during the cutting process, the carrier being receivable in a support assembly comprising a plurality of rollers on which the carrier is able to move, the support assembly further comprising a locking mechanism configured to lock the carrier relative to the support assembly when the carrier is correctly placed relative to the cutting station.

19. A machine as claimed in claim 18, wherein the carrier is substantially T-shaped and has a flange with stepped side walls, the carrier being supported by the support assembly and being able to move longitudinally relative to the support assembly and being able to have a small lateral relative movement relative to the support assembly; the support assembly having side walls that are correspondingly-shaped to the side walls of the carrier.

20. A machine as claimed in claim 19, wherein the rollers project inwardly from the side walls of the support assembly at a lower end thereof; the rollers engaging under lowermost surfaces of the stepped side walls of the carrier.

21. A machine as claimed in claim 19 or claim 20, wherein the locking mechanism comprises a downwardly-angled end configured to engage under a correspondingly-angled upper portion of the side walls of the carrier to lift the lower surface of the side walls of the carrier off the rollers and to move the carrier laterally relative to the support assembly such that the opposite side wall of the carrier locks against its corresponding side wall of the support assembly.

22. A machine to be used in the cutting of a blank into individual items, the machine comprising a wire feeder and a wire receiver, the wire feeder and the wire receiver being generally parallel and spaced apart; the wire feeder being for supplying a plurality of parallel cutting wires to a cutting station and the wire receiver being for receiving the plurality of cutting wires from the cutting station;

the cutting station comprising at least one tank for receiving therein a solution, the at least one tank having two spaced apart and generally parallel side walls, there being two spaced apart and generally parallel end walls joining ends of the side walls; each of the plurality of wires passing through an opening in the side walls in a non-fluid-tight manner such that the solution can pass through the openings during operation of the machine.

23. A machine as claimed in claim 22, where each of the side walls is double walled and comprises an inner side wall and an outer side wall parallel to and spaced from the inner side wall to form a side wall gap therebetween; the flow of the solution into the at least one tank being via the side wall gap and over the top edge of the inner side wall.

24. A machine as claimed in claim 22 or claim 23, wherein each of the end walls is double walled and comprises an inner end wall and an outer end wall parallel to and spaced from the inner end wall to form an end wall gap therebetween; a partial flow of the solution out of the tank being over the upper edge of the inner end wall and via the end wall gap.

25. A machine as claimed in claim 24, wherein a rate of supply of the solution is equal to a sum of the solution outflow through the openings and over the upper edges of the end wall.

26. A machine as claimed in any one of claims 22 to 25, wherein the opening is selected from the group consisting of: one opening for each wire, a plurality of openings each being for a group of wires, and one opening in each of the side walls with all wires passing through that one opening.

27. A machine as claimed in claim 26, wherein the one opening in each of the side walls is through the inner side walls and the outer side walls.

28. A machine as claimed in any one of claims 22 to 27, wherein the openings are below the top edge of the inner side wall.

29. A machine to be used in the cutting of a blank into individual items, the machine comprising a wire feeder and a wire receiver, the wire feeder and the wire receiver being generally parallel and spaced apart; the wire feeder being for supplying a plurality of parallel cutting wires to a cutting station and the wire receiver being for receiving the plurality of cutting wires from the cutting station; the cutting station comprising at least one tank for receiving therein a solution; all cutting of the blank taking place in the solution, the solution having a laminar flow in the at least one tank.

30. A machine as claimed in claim 29, wherein the at least one tank has two spaced apart and generally parallel side walls, there being two spaced apart and generally parallel end walls joining ends of the side walls; all input of the solution being over a top edge of each of the side walls and the solution being able to pass out of the at least one tank over an upper edge of each of the end walls.

31. A machine as claimed in claim 30 further comprising at least one outlet at a lower edge of each of the end walls through which the solution can pass after passing over the upper edge of the end walls.

32. A machine as claimed in claim 30 or claim 31, where each of the side walls is double walled and comprises an inner side wall and an outer side wall parallel to and spaced from the inner side wall to form a side wall gap therebetween; the flow of the solution into the at least one tank being via the side wall gap and over the top edge of the inner side wall.

33. A machine as claimed in claim 32, wherein the top edge of the inner side wall is serrated or scalloped.

34. A machine as claimed in claim 32 or claim 33, wherein the inner side wall is of a lower height than the outer side wall.

35. A machine as claimed in claim any one of claims 32 to 34, where each of the end walls is double walled and comprises an inner end wall and an outer end

wall parallel to and spaced from the inner end wall to form an end wall gap therebetween; a partial flow of the solution out of the tank being over the upper edge of the inner end wall and via the end wall gap.

36. A machine as claimed in claim 35, wherein the inner end wall is of a lower height than the outer end wall.

37. A machine as claimed in claim 35 or claim 36, wherein the upper edge of the inner end wall is serrated or scalloped.

38. A machine to be used in the cutting of a blank into individual items, the machine comprising a wire feeder and a wire receiver, the wire feeder and the wire receiver being generally parallel and spaced apart; the wire feeder being for supplying a plurality of parallel cutting wires to a cutting station and the wire receiver being for receiving the plurality of cutting wires from the cutting station; the cutting station comprising at least one tank for receiving therein a solution; and a carrier for holding the blank during the cutting process, the carrier being receivable in a support assembly comprising a plurality of rollers on which the carrier is able to move, the support assembly further comprising a locking mechanism configured to lock the carrier relative to the support assembly when the carrier is correctly placed relative to the cutting station.

39. A machine as claimed in claim 38, wherein the carrier is substantially T-shaped and has a flange with stepped side walls, the carrier being supported by the support assembly and being able to move longitudinally relative to the support assembly and being able to have a small lateral relative movement relative to the support assembly; the support assembly having side walls that are correspondingly-shaped to the side walls of the carrier.

40. A machine as claimed in claim 39, wherein the rollers project inwardly from the side walls of the support assembly at a lower end thereof; the rollers engaging under lowermost surfaces of the stepped side walls of the carrier.

41. A machine as claimed in claim 39 or claim 40, wherein the locking mechanism comprises a downwardly-angled end configured to engage under a correspondingly-angled upper portion of the side walls of the carrier to lift the lower surface of the side walls of the carrier off the rollers and to move the carrier laterally relative to the support assembly such that the opposite side wall of the carrier locks against its corresponding side wall of the support assembly.

42. A machine as claimed in any one of claims 1 to 41, wherein the blank is an ingot of a semiconductor or other material

43. A method to cut a blank into individual items, the method comprising:

(a) attaching the blank to a bottom of a carrier;

(b) engaging the carrier with a support assembly;

(c) moving the carrier with the blank longitudinally relative to the support assembly until the blank is directly above a cutting station;

(d) lowering the support assembly with the carrier and the blank until a bottom of the blank contacts a plurality of cutting wires and is below a top of a tank containing a solution; and

(e) cutting the blank into the individual items while at least a relevant portion of the wires is in the solution in the tank.

44. A method as claimed in claim 43, wherein at (d) the wires are in the solution.

45. A method as claimed in claim 43, wherein at (d) the wires are slightly above the solution and the support assembly continues to move downwardly at a controlled rate until the wires deform slightly under the applied pressure of the blanks such that the wires are now in the solution at least for the full width of the blanks.

46. A method as claimed in anyone of claims 43 to 45, wherein all cutting of the blank by the wires takes place in the solution.

47. A method as claimed in any one of claims 43 to 46, wherein the relevant portion of the wires is in the solution during all stages of the cutting action.

48. A method as claimed in claim 47, wherein the relevant portion is that portion of the wires in a cutting station and being at least for the full width of the blank..

49. A method as claimed in any one of claims 43 to 48, wherein the wires are able to operate in a forwards and a reverse mode.

50. A method as claimed in any one of claims 43 to 49, wherein the wires are diamond wires.

51. A method as claimed in any one of claims 43 to 50, wherein the longitudinal movement in (c) is a rolling movement.

52. A method as claimed in any one of claims 43 to 51, wherein the blank is an ingot of a semiconductor or other material.