A METHOD AND APPARATUS FOR FLIPPING INTERGRATED CIRCUITS CHIPS

Field Of Invention

The present invention relates generally to an automated machine, more particularly, to apparatus and method for flipping integrated circuit (IC) chips and the like.
Background Of The Invention

Flipper machines are typically used in the manufacture of IC chips. The operations of conventional machines used are rather challenging. Since machine speed corresponds with throughput, the faster the flipper machine runs, the less costly the process and the productivity also increase. The invention is a solution to provide semiconductors manufacturers a faster throughput speed on their manufacturing processes, specifically on the backend processes of testing and packaging of their products requiring work to be done on multiple sides of the package (i.e. top, sides, or bottom).

Typically, the type of work done is of marking, inspection and test, hence, the invention relates closely but not

limited to the design and manufacture of test handlers, in which, packages of semiconductor or other electronics devices are tested for various characteristics before it is pass on to subsequent processes or endorsed as a finished product. These packages are manipulated to allow work processes (making, tests or inspection) to be conducted automatically. The industry has benefited a lot from automation, facilitating all these processes to be done at very high speed not achievable by humans. One of the manipulations required is to flip the packages to multiple angles to allow processes to be done on the packages. Typically, the package is flipped 180 degrees to allow processes to be carried out and depending on the subsequent processes, it may be flipped back again to its normal orientation.

The machines according to prior art receives an IC from a a placement head having a nozzle for releasably holding the IC, the first arm that receives the IC then passes it to a second arm thus flipping the IC. This process may well work for a particular speed. In order to increase productivity it is always necessary to keep increasing the speed of these machines. However, after a certain speed the machine

does not work as the said ICs would fly off the arm due to catapult effect.

Therefore, there is demand to have a flipper machine that works at much higher speed.

Brief summary of invention

An implementation consisting of multiple units of a flipper mechanism that carries an object to be worked and it is mounted on the circumference of a rotating circular platform. The rotating circular platform is indexed and stops intermittently as it make a complete rotation so that each flipper mechanism is transported sequentially to stop at all workstations that are mounted in a corresponding circular layout of the platform to allow work to done on the object. In addition to transport the work objects to multiple workstations in a circular manner, the flipper have the capability to flip or rotate the object into positions that expose any sides of the object to face upwards to allow work to be one on it. This mechanism caters for work to be done at multiple angels within the rotary planes of the embodiment of the flipper mechanism.

The object is placed, which can conceivably being achieved by a pick and place mechanism, to sit and held in place in a cavity on the embodiment, which in turn, will be rotated or flipped. The cavity is formed with an appropriate material with a through slot precisely formed or machined to the shape of the object or any other shape that fits. The through slot is sandwiched with two similar, if not identical lateral moveable plates that when extended outwards, it will cover the through slot to its entirely. Conversely, when the plate is retracted inwards, the through slot is revealed. The plates move independently of each other but their movements are arranged so that the bottom plate is extended to serve as a base for the object to sit in. The top and bottom plates are switched interchangeably each time the cavity is rotated. The top plate will act as a cover to prevent the object from falling out of the cavity as it is being rotated. Once the rotation is completed, the top plate, which was previously the bottom plate, is retracted to expose the object for work. The bottom plate, which was previously the top plate, remains extended to be a base for the object to sit on. The two plates have provisions of vacuum passage to supply vacuum suction force to hold the object securely when it acts as a base (i.e. when plate is at bottom position) The

plates are moved outwards and inwards by way of implementing a cam follower over a cam profile or by any other means that will achieve the desired movements of the plates.

Both plates, when extended to cover the cavity, form a flange that will allow a receptacle or a gripper device to facilitate the rotation. It can be envisaged that the flange formed by the fully covered cavity is positioned into a slot of a receptacle, which in turn, is rotated thus effectively flipping the object in the cavity. To prevent unnecessary or accidental rotation of the cavity, a locking mechanism is incorporated that will only disengage to allow the cavity to rotate freely on the lateral axis. The locking mechanism is re-engaged to lock the embodiment after the cavity has successfully being rotated by the receptacle.

For added safety, the locking mechanism is designed to only unlock and allow rotation when the flange, formed by the upper and lower plates, has been successfully engaged to the receptacle. Effectively changing the locking effect to the receptacle. The invention will not be able to rotate at any rest state.

Implementation of the invention will be of great essence, in particular to the provision of automated solutions of turret-based systems. Multiple units on the invention are spread evenly on the circumference of a circular and rotating table, transporting and flipping the object to be worked on across multiple stages of work at high speed indexing sequences. Similarly, implementation can also be applied on linear systems when the objects are transported linearly instead of rotary motion.

The above is achieved by providing a method for flipping Integrated Circuit chips comprising the steps of:placing chip into a holder; inserting holder in between the fork of a bifurcate member; and rotating said bifurcate member to rotate the said holder and the chips.

The invention is also achieved by providing a holder for use in apparatus for flipping electronic circuit chips, which comprises a body member for mounting on an indexing turntable, the body portion having a front end portion and a rear end portion with the rear end portion being directed towards the axis of the turntable, when mounted thereon, the body member having a passage extending therethrough, the passage through at least the rear end portion of the

body member being circular in section, and a chip holding member having front and rear end portions, the rear end portion comprising a cylindrical rod received in the circular passage in the body member so as to be rotatable and slidable in said passage and the front end portion having a chip holding aperture with associated closure members, one on each side of the aperture and independently slidable relative to the aperture such that the aperture can be open or closed on one or both sides, locking means being formed on the rear face of the chip holding member and the front face of the body member such that such means, when engaged, prevent the chip holding member from being rotated, and resilient means being provided to urge the locking means to the engaged position.

Furthermore the apparatus for flipping electronic circuit chips, comprising a plurality of holders according to the above mounted around the periphery of an indexing turntable with the rear end portions of the chip holding members in contact with a first stationary cam surface for releasing the locking means at a chip flipping location and means associated with one or the other aperture closure members being in contact with a second stationary cam surface for sliding an aperture closure member to the closing position.

Brief description of drawings

A better understanding of the invention is better obtained when the detailed description of the embodiment of the invention set forth below is considered in conjunction with the accompanying drawings, in which:

Fig 1 is perspective view of a single unit of the flipper mechanism.

Fig 2 is another perspective view of a single unit of the flipper mechanism with the top plate opened exposing the cavity, where the object will be placed

Fig 3 is an exploded view of the flipper mechanism.

Fig 4 is the invention in position in a receptacle to facilitate the rotation.

Fig 5 illustrates multiple flipper units mounted to a rotating disc in order to practically use the invention in the production of Integrated Circuits.

Fig 6 shows the attachment between the rollers and cam.

Detailed description of invention

The invention basically comprises a flipper unit to rotate an IC if it is in the opposite orientation. The IC may be rotate to be in the preferred terminals up or terminals down position. The flipper mechanism according to the present invention as shown in Figure 1 comprises a main arm (30) mounted on a hollow block (40). Said block is preferably V shaped at one end. The V-shaped block (40) is fixed permanently on to the rotating platform. The main arm (30) is shaped similar to a tuning fork as illustrated on Fig 3. The rod end of the main arm (30) is inserted telescopically into the hollow section of the V-shaped block (40) preferably at the middle of the block that is fitted with either bearings or bushing that will allow rotation motion of the main arm. The open ends of the V-shaped block (41) have a step (41) that will fit the perpendicular portion (32) of the main arm (30) so that rotation is prohibited when the main arm (30) is flushed fully to the V-shaped block (40). The flush force is accomplished via a spring-like action mounted at the other end of the V-shaped block. The return mechanism (31) is

implemented by way of a spring that the main arm (30) will always be flushed to the V-shaped block, hence prohibiting rotation at rest state. It is also conceivable that the return mechanism such as application of coils, plates, or other spring like components can be implemented to achieve the same. The end of the main arm (30) has a roller (33) that can be manipulated by any conceivable actuators to push the main arm (30) against the return mechanism (31) outwards from the V-shaped block (40), releasing the main arm (30) from the groove (41) to allow rotation.

Referring to Fig 3, a rectangular plate (24) with a through slot shaped to fit the object to be processed (27) at one end will be fitted to the main arm (30) at the fork. The plate (24) is fitted between the open slots (33) of the fork and the cross flanges (26) of the plate (24). The main arm (30) and the rectangular plate (24) are built along the rotational axis of the embodiment. The rectangular plate (24) will have two other but identical plates (21), acting as covers, rested in the inner side the forks of the main arm (30), both covering the rectangular plate (24). An outer and final set of plates (25) is incorporated to hold the covers (21) and the rectangular plate (24) in place, mounted in the wall of the fork on the main arm (30) and it

has a flange (28) that closes the open slots (33) of the fork on the main arm (30). The outer plates (25) have provisional grooves that will allow the covers (21) to slide inward or outwards of the main arm (30). To control the sliding stroke of the covers (21), a pusher block (22) is fastened on the inner end of the covers (21). The block (22) is visually a protrusion from outer plate (25) and its width has slide fit properties and will slide along the slot on the outer plate (25). The stroke of the cover (2) is limited by the stroke of the block (22) along the slot on the outer plate (25).

Referring to Fig 1 and 2, the block (22), is moved or manipulated over a bearing or roller or other variants that functions as a cam follower (23) fastened on the top of the block (22). Fig 1 shows the position of the block (22), which closes the cover (21) to the entirety of the rectangular plate. The movement of the block (22), which ultimately controls the stroke of the covers (21) is limited and controlled by the length of the slot at the outer plate (25). Fig 2 shows the position of the block (22) that opens the cover that reveals the slot (27) on the rectangular plate (24), which forms the cavity where the object will sit in. The manipulation of the cam follower

(23) on the pusher block (22) is achieved by an inner cam profile. The cam profile is designed is such a way that the pusher block (22) will only retract or extend the cover (21) at appropriate intervals (i.e., extended to close cavity during rotation and retracted to open cavity for work to be done). The cover (21) at the bottom side remains closed. The closed position of the cover (21) is assured by a coil spring (not shown) sprung around the pusher block (22) in a manner that will always force the block to extend the cover (21) at rest state.

In Fig 2, a vacuum suction hole (20) is visible. The vacuum suction hole is featured to provide a firmer hold of the object in the cavity. The vacuum suction has its passage machined through the middle portion of the cover (21) and ends to congregate another passage at the rectangular plate (24) and finally through the main arm (30) where air tubing is fitted at the end of the main arm (30) from the center point of the rotating platform.

Fig 4 shows the invention in position within a receptacle (51) that will facilitate the rotation of the embodiment. The fully closed covers (21) form a flange that will fit into the receptacle (51) that can be rotated by way of a

motor (50) or any conceivable actuator that provides rotating motion. The main arm (30) is extended into the receptacle (51) at the roller (33) and at same time disengaging the main arm (30) from the step (41) at the v-shaped block (40) that prohibits rotation, to allow rotation. The spring mechanism (31) between the roller (33) and the v-shaped block (40) will return the embodiment into locked position once the rotation is completed and the pusher is relieved from the roller (33). Effectively, this forms a two-step, extend and rotate mechanism.

Referring to Fig 5, the extension is achieved via a outer cam profile (63) from a cam (64), forcing the roller (33) on the main arm (30) to roll over the profile and effectively pushing the main arm (30) out of the slot (41) on the v-shaped block, thus unlocking the main arm (30) for rotation. The same can also be achieved with other actuator such as pneumatic or electric actuator. The lock provided by the step (41) on the v-shaped block (40) prohibits unnecessary rotation but does not prevent unintended extension of the main arm (30) that will effectively cause the main arm (30) to be free to rotate. To prevent this, a pin (34) acts as additional lock to prohibit the main arm (30) to be extended manually or by centrifugal force as the

circular table (60) rotates at high speed. The pin (34) is slotted vertically into a groove that has a circular path machined on the same cam (64) that has the outer cam profile (63) designed to extend the main arm (30) out of the slot (41) on the v-shaped block (40). The groove on the cam (64) is not continuous. The path of the groove breaks to release the pin (34) to allow extension of the main arm by the outer cam profile (63). The broken path of the groove profile corresponds to the size of the outer cam profile (63). This means that the outer cam profile will begin to extend the main arm (30) at the point where the groove breaks. The reverse is also true; the outer cam profile will complete the retraction of the main arm (30) as the pin (34) re-enters the path of the groove.

Fig 5 illustrates the implementation of multiple units of the flipper mechanism (10) in a turret system. The embodiment is fastened onto a circular rotating table (60) at the V-shaped block (40) of the embodiment. The units are laid out at the circumference of the rotating table (60), which is mounted on a high speed and precision motor (61). The inner cam profile (62) is designed to specifications that will manipulate the cam followers (23) that will eventually open or close the cover (21) of the invention.

The implementation of the invention is not limited to turret systems. Other forms of implementation, such as linear based, can also be applied to achieve the same objective.

The invention is advantageous over prior art as it allows multiple stations of rotation to be implemented and at the same time, reduces the motion needed to achieve the same, thus increasing the potential of higher throughput speed.

Claims

1) A method for flipping Integrated Circuit chips comprising the steps of:

placing chip into a holder;

inserting holder in between the fork of a bifurcate member;

and rotating said bifurcate member to rotate the said holder and the chips.

2) A holder for use in apparatus for flipping electronic circuit chips, which comprises a body member for mounting on an indexing turntable, the body portion having a front end portion and a rear end portion with the rear end portion being directed towards the axis of the turntable, when mounted thereon, the body member having a passage extending therethrough, the passage through at least the rear end portion of the body member being circular in section, and a chip holding member having front and rear end portions, the rear end portion comprising a cylindrical rod received in the

circular passage in the body member so as to be rotatable and slidable in said passage and the front end portion having a chip holding aperture with associated closure members, one on each side of the aperture and independently slidable relative to the aperture such that the aperture can be open or closed on one or both sides, locking means being formed on the rear face of the chip holding member and the front face of the body member such that such means, when engaged, prevent the chip holding member from being rotated, and resilient means being provided to urge the locking means to the engaged position.

3) Apparatus for flipping electronic circuit chips, comprising a plurality of holders according to claim 2 mounted around the periphery of an indexing turntable with the rear end portions of the chip holding members in contact with a first stationary cam surface for releasing the locking means at a chip flipping location and means associated with one or the other aperture closure members being in contact with a second stationary cam surface for sliding an aperture closure member to the closing position.

4) A flipper mechanism comprising several flipper units as claimed in the preceding claims comprising;

a rotating disc having flipper units attached at spaced intervals along the periphery of the disc in order to stop at a predetermined workstations.

5) A flipper unit as claimed in claim 4 wherein cams are attached to the upper and lower plates in order to control the movement of the plates.

6) An apparatus for flipping Integrated Circuit Chips comprising;

a chip holder;

a holder rotating means which is mounted in a fixed position with a chip holder receiving recess;

means for bringing chip one at a time in contact into said recess;

wherein when necessary the rotating means is actuated in order to rotate the chip holder.

7) A turret system comprising a plurality of chip holding means attached to an indexing table wherein said table comprising:

a primary cam for engaging with the chip holding means in order to longitudinally exert said holder into a holder receiving recess;

said holder receiving recess to rotate once chip holding means is extended in.

8) A chip holder as claimed in the preceding claims

wherein to hold the IC or the like firmer a vacuum suction is provided where it includes a passage extending through the chip holding means and ends to congregate another passage at the rectangular plate (24) and finally through the cylindrical rod where air tubing is fitted at the end of the cylindrical rod from the center point of the rotating platform.