# 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 plurality of flipper units that carries an object to be worked and it is mounted on the circumference of a rotating indexing turntable. The rotating indexing turntable is indexed and stops intermittently as it make a complete rotation so that each flipper unit 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 cavity 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 slidable closure plates that when extended outwards, it will cover the cavity to its entirely. Conversely, when the plate is retracted inwards, the cavity 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 of an actuating 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 means is incorporated that will only disengage to allow the cavity to rotate freely on the lateral axis. The locking means is re-engaged to lock the embodiment after the cavity has successfully being rotated by the receptacle.

For added safety, the locking means 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.

A method of manipulating IC chips to be worked for different sides comprising the steps of inserting an elongate holder of a holding member of flipper unit into a receptacle of an actuating device which is placed adjacent to said flipper unit; disengaging said holding member from a body member of flipper unit at the locking means for allowing pivotal rotation of said holding member; and rotating said receptacle to rotate said elongate holder having said semiconductor water enclosed thersein.

The invention is also achieved by providing a flipper unit for use in apparatus for manipulating 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 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  front end portion having an elongate holder formed with holder plate sandwiched with a pair of closure plates, said holder plate is formed with a cavity and said closure plates are independently slidable relative to said holder plate such that said cavity can be opened or closed on one or both sides and locking means being formed on the rear face of the holding member and the front face of the body member such that such means, when engaged, prevent the 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 holding members in contact with an inner 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 an outer

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 the flipper unit of the present invention.

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

Fig 3 is an exploded view of the flipper unit.

Fig 4 is a perspective view flipper unit having its elongate holder positioned in a receptacle to facilitate the rotation.

Fig 5 illustrates a perspective view showing a plurality of flipper units mounted to a rotating disc in order to

practically use the invention in the production of Integrated Circuits.

Fig 6 shows a perspective view of the flipper unit showing the attachment between the rollers and cam.

**Detailed Description of Invention**

The invention basically comprises a flipper unit to rotate IC chips if it is in the opposite orientation. The IC may be rotated to be in the preferred terminals up or terminals down position. The flipper unit (10) according to the present invention as shown in Figure 1 comprises a holding member (30) mounted on a body member (40). The body member (40) includes a passage (40a) longitudinally extended through the entire length of the body member (40) and the body member (40) is preferably tapered at one end. The body member (40) is fixed permanently on to an indexing turntable. The holding member (30) includes a holding block (57) formed in a fork-like shape having an opened channel (58) in between the forks for receiving an elongate holder (24) as illustrated in Figure 3. At the rear end of the holding member (30) includes a cylindrical rod (59) inserted telescopically into the passage (40a) of the body member (40) preferably at the middle of the

body member (40) that is fitted with either bearings or bushing that will allow pivotal rotation motion of the holding member (30). The open end of the body member (40) has a step (41) that will fit a perpendicular portion (32) at the rear end of the holding member (30) so that rotation is prohibited when the holding member (30) is flushed fully to the body member (40). The flush force is accomplished via a spring-like action mounted at the tapered end of the body member (40). The return mechanism (31) is implemented by way of a resilient means (31) that the holding member (30) will always be flushed to the body member (40), 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 rod (59) end of the holding member (30) is mounted with a roller (33) that can be manipulated by any conceivable actuators to push the holding member (30) against the return mechanism (31) outwards from the body member (40), releasing the holding member (30) from the step (41) to allow rotation.

Referring to Figure 3, a holder plate (24) with a cavity (27) shaped to fit the IC chips to be worked at one end will be fitted to the holding member (30) at the fork. The holder plate (24) is fitted between the open slots (35) of the fork

and the cross flanges (26) of the holder plate (24). The holding member (30) and the holder plate (24) are built along the rotational axis of the embodiment. The holder plate (24) has two slidable closure plates (21), acting as covers, rested in the inner side of the forks of the holding member (30). The holder plate (24) is sandwiched in between the two slidable closure plates (21). A pair of outer plates (25) is incorporated to hold the closure plates (21) and the holder plate (24) in place at the respective sides of the holding member (30), mounted in the wall of the fork on the holding member (30) and it has an end flange (28) that closes the open slots (35) of the fork on the holding member (30). The outer plates (25) have provisional grooves (25a) that allow the closure plates (21) to slide inward or outwards of the holding member (30). To control the sliding stroke of the closure plates (21), a pusher block (22) is fastened on the inner end of the closure plates (21). The pusher 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 closure plate (21) is limited by the stroke of the pusher block (22) along the slot on the outer plate (25).

Referring to Figures 1 and 2, the pusher block (22), is moved or manipulated over a bearing (23) or roller or other variants that functions as a cam follower (23) fastened on the top of the pusher block (22). Figure 1 shows the position of the pusher block (22), which closes the closure plate (21) to the entirety of the holder plate (24). The movements of the pusher block (22), which ultimately controls the stroke of the closure plates (21) is limited and controlled by the length of the slot at the outer plate (25). Figure 2 shows the position of the pusher block (22) that pulls the closure plate (21) that reveals the through slot (27) on the holder 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 closure plate (21) at appropriate intervals (i.e., extended to close cavity during rotation and retracted to open cavity for work to be done). The closure plate (21) at the bottom side remains closed. The closed position of the closure plate (21) is assured by a coil spring (not shown) sprung around the pusher block (22) in a manner that will always force the pusher block (22) to extend the closure plate (21) at rest state.

In Figure 2, a vacuum suction hole (20) is visible. The vacuum suction hole (20) is featured to provide a firmer hold of the object in the cavity. The vacuum suction hole (20) has its passage machined through the middle portion of the closure plate (21) and ends to congregate another passage at the holder plate (24) and finally through the holding member (30) where air tubing is fitted at the end of the holding member (30) from the center point of the indexing turntable.

Figure 4 shows the invention in position within a receptacle (51) that will facilitate the rotation of the embodiment. The fully closed closure plates (21) form a flange that will fit into the receptacle (51) of an actuating device that can be rotated by way of a motor (50) or any conceivable actuator that provides rotating motion. The holding member (30) is extended into the receptacle (51) at the roller (33) and at same time disengaging the holding member (30) from the step (41) at the body member (40) that prohibits rotation, to allow rotation. The spring mechanism (31) between the roller (33) and the body member (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 Figure 5, the extension is achieved via an inner cam profile (63) from a cam (64), forcing the roller (33) on the holding member (30) to roll over the cam profile (63) and effectively pushing the holding member (30) out of the step (41) of the body member (40), thus unlocking the holding member (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 body member (40) prohibits unnecessary rotation but does not prevent unintended extension of the holding member (30) that will effectively cause the holding member (30) to be free to rotate. To prevent this, a pin (34) acts as additional lock to prohibit the holding member (30) to be extended manually or by centrifugal force as the circular table (60) rotates at high speed as shown in figures 4 and 5. The pin (34) is slotted vertically into a groove that has a circular path machined on the same cam (64) that has the inner cam profile (63) designed to extend the holding member (30) out of the step (41) on the body member (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 holding member (30) by the inner cam profile (63). The broken path of the groove profile corresponds to the size of the inner cam profile (63). This means that the inner cam profile (63) will begin to extend the

holding member (30) at the point where the groove breaks. The reverse is also true; the inner cam profile (63) will complete the retraction of the holding member (30) as the pin (34) re-enters the path of the groove.

Figure 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 body member (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 (63) is designed to specifications that will manipulate the cam followers (23) that will eventually open or close the closure plate (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 of flipping Integrated Circuit chips to be worked on different sides comprising the steps of:
inserting an elongate holder of a holding member of flipper unit into a receptacle of an actuating device which is placed adjacent to said flipper unit;
disengaging said holding member from a body member of flipper unit at the locking means for allowing pivotal rotation of said holding member; and
rotating said receptacle to rotate said elongate holder having said IC chips enclosed therein.

2. The method of flipping IC chips to be worked on different sides as claimed in claim 1, wherein said step further comprising the steps of:
retracting a first cover plate of a pair of closure plates which is slidably sandwiched a holder plate to reveal a cavity formed at said holder plate for receiving said chips;
placing said chips into said cavity of the holder plate by a pick and place mechanism; and
covering said cavity having said chips rested on a second cover plate of the pair of closure plates prior to the step of inserting said elongate holder.

3. The method of flipping IC chips to be worked on different sides as claimed in claim 2, wherein said step of placing said water into the cavity includes the step of removing a worked chip in said cavity by said pick and place mechanism after a completed process cycle.

4. The method of flipping IC chips to be worked on different sides as claimed in the preceding claims, wherein said step further comprising of the step of retracting said second cover plate to reveal other side of said chips in said cavity after the holding member is rotated.

5. A flipper unit for use in an apparatus for flipping IC chips comprising:

a body member for mounting on an indexing turntable, said body member having a front end portion and a rear end portion with said rear end portion being directed towards the axis of said turntable, whereby said body member includes a passage extending through at least the rear end portion of the body member, and

a holding member having front and rear end portions, said rear end portion includes a cylindrical rod rotatably and slidably received in said passage of the body member and said front end

portion having an elongate holder formed with holder plate sandwiched with a pair of closure plates, said holder plate is formed with a cavity and said closure plates are independently slidable relative to said holder plate such that said cavity can be opened or closed on one or both sides.

6. The flipper unit for use in an apparatus for flipping IC chips as claimed in claim 5, wherein said front end portion of the holding member further includes a holding block formed in a fork-like shape having opened channel in between said forks for receiving said elongate holder.

7. The flipper unit for use in an apparatus for flipping IC chips as claimed in claim 6, wherein said holder block has a pair of outer plates fixed to said holding block at opposing sides for holding the pair of cover plates.

8. The flipper unit for use in an apparatus for flipping IC chips as claimed in claim 7, wherein each of said outer plate has a groove for allowing a pusher block mounted on said outer plate and fastened to an inner end of said closure plate through said groove for controlling the sliding strokes of the closure plate.

9. The flipper unit for use in an apparatus for flipping IC chips as claimed in claim 5, wherein said flipper unit further comprising locking means being formed on said rear face of said holding block of the holding member and the front face of the body member such that said locking means, when engaged, prevent the holding member from being rotated, and resilient means being provided to urge the locking means to the engaged position.

10. The flipper unit for use in an apparatus for flipping IC chips as claimed in claim 5, wherein said closure plate includes a vacuum passage extending through said closure plate and ends to congregate another passage at said holder plate and finally through the cylindrical rod where air tubing is fitted at the end of said cylindrical rod from the center point of said indexing turntable.

11. A turret apparatus comprising a plurality of flipper units attached to an indexing table whereby said indexing table includes a inner cam profile for engaging with said holding member in order to longitudinally exert said elongate holder into a receptacle of an actuating device, and said receptacle is rotated once said elongate holder is extended in.

12. The turret apparatus as claimed in claim 11, wherein said holding member having its cylindrical rod in contact with an inner cam profile for releasing the locking means at a chip flipping location and means associated with one or the other aperture closure plate being in contact with an outer for sliding an aperture closure plate to the closing position.

13. The turret apparatus as claimed in claim 11, wherein said apparatus further 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.

14. The turret apparatus as claimed in claim 11, wherein said cams are attached to the upper and lower plates in order to control the movement of the plates.