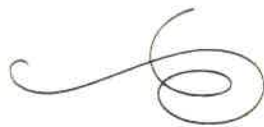
United States of America



To Promote the Progress of Science and Useful Arts

The Director

of the United States Patent and Trademark Office has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this United States

Patent

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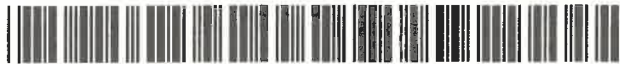
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Lim et al.

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(54) **APPARATUS AND METHOD FOR PROCESSING SPUTTERED IC UNITS**

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(58) **Field of Classification Search**
CPC C23C 14/50; C23C 14/34
See application file for complete search history.

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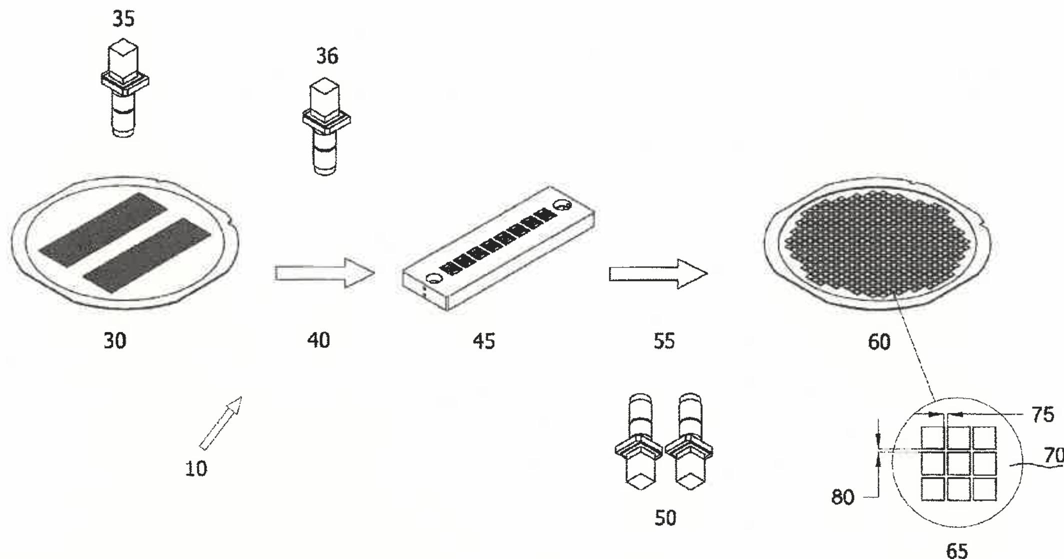
Primary Examiner — Jason Berman

(57) **ABSTRACT**

A method for preparing a film carrier for sputtering of IC units placed thereon, the method comprising the steps of: providing a carrier of IC units; removing said units from the carrier; delivering said IC units to a flipper; inverting and delivering said units to a sputtering film frame; placing the units on said sputtering film frame in an array having a pre-determined clearance about adjacent units.

5 Claims, 7 Drawing Sheets



(51) **Int. Cl.**
H01L 21/67 (2006.01)
H01L 21/683 (2006.01)

(52) **U.S. Cl.**
CPC .. ***H01L 21/67144*** (2013.01); ***H01L 21/67265*** (2013.01); ***H01L 21/6836*** (2013.01); *H01L 2221/68386* (2013.01)

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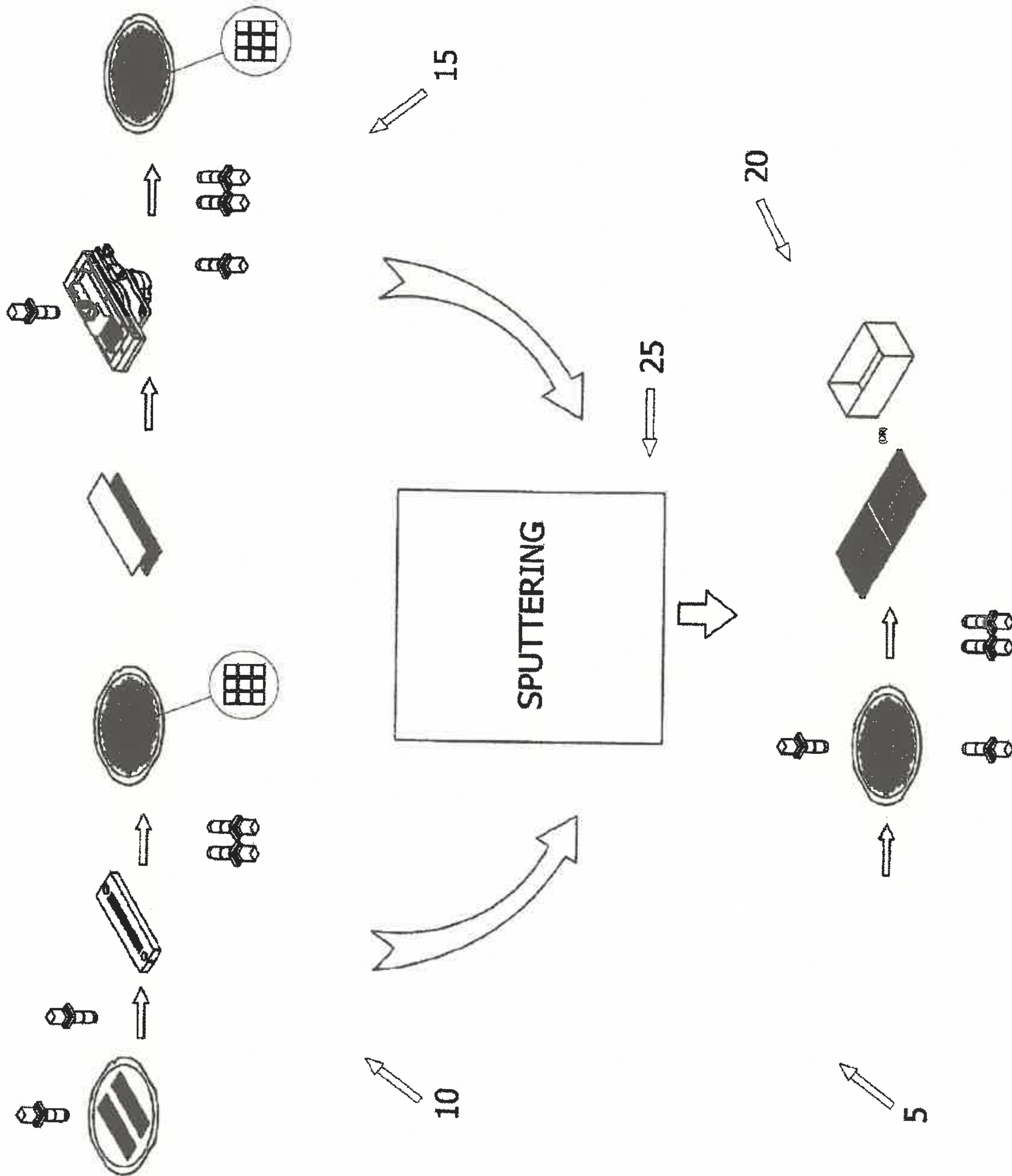

Figure 1

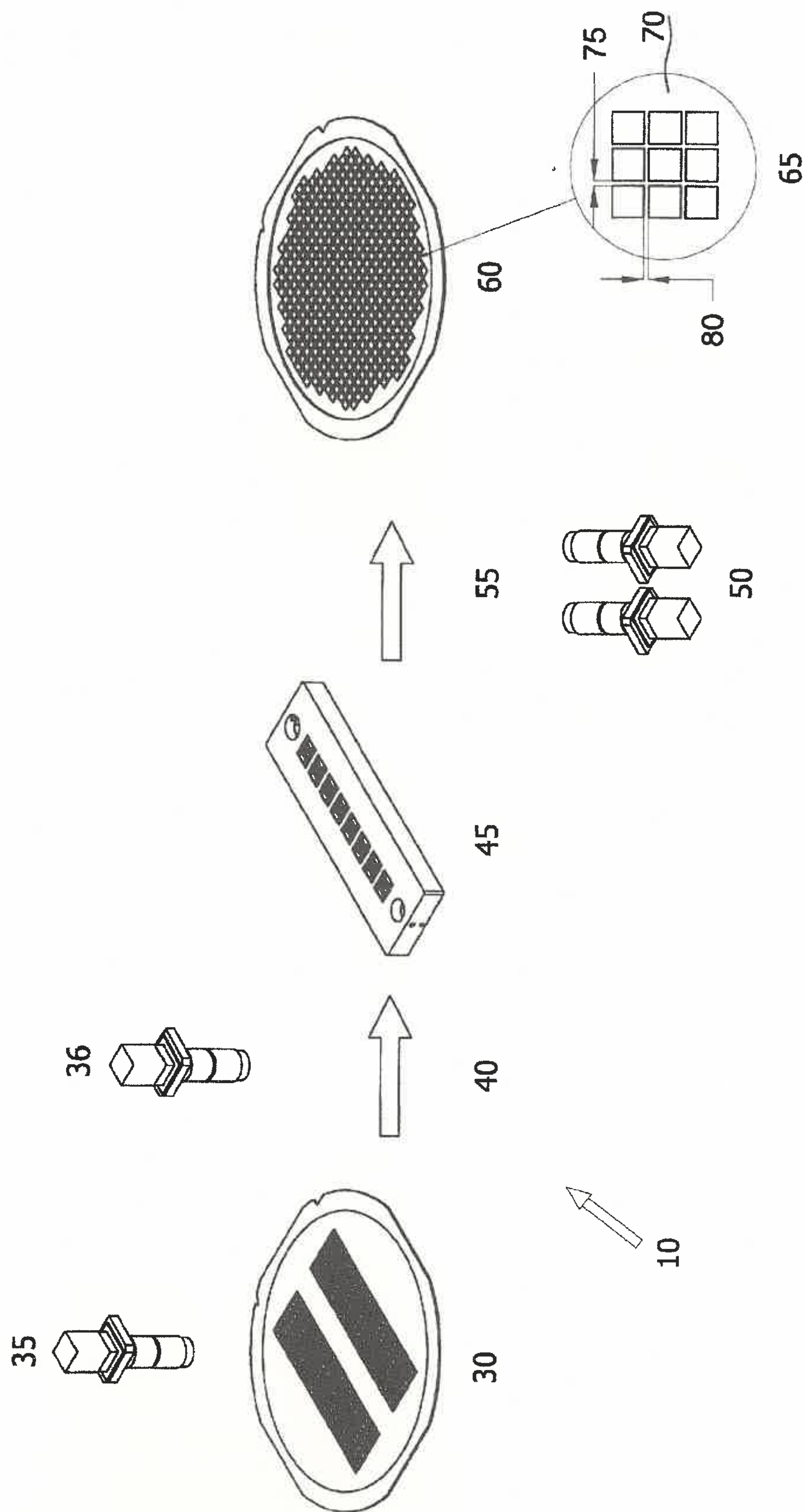

Figure 2

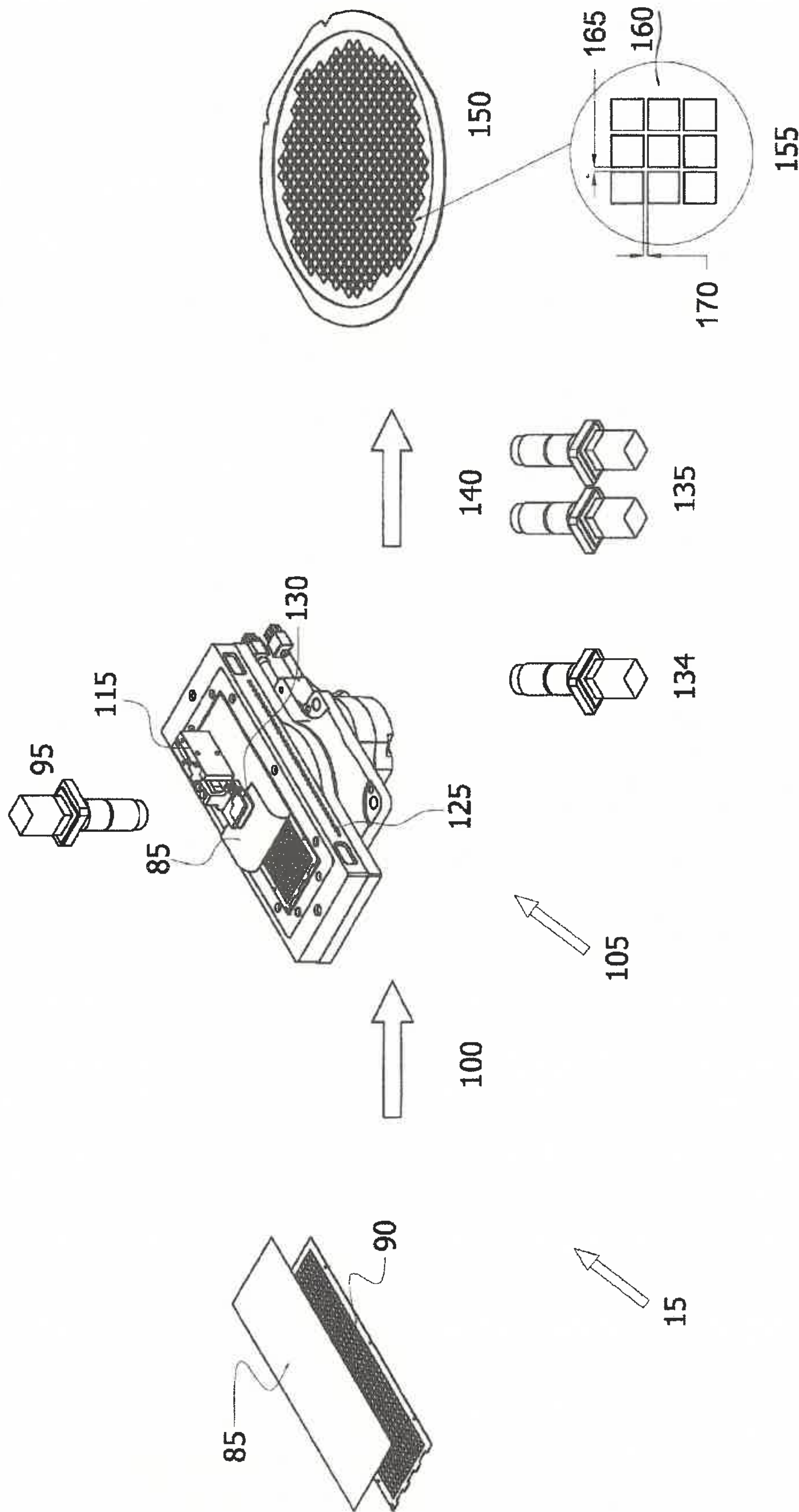

Figure 3

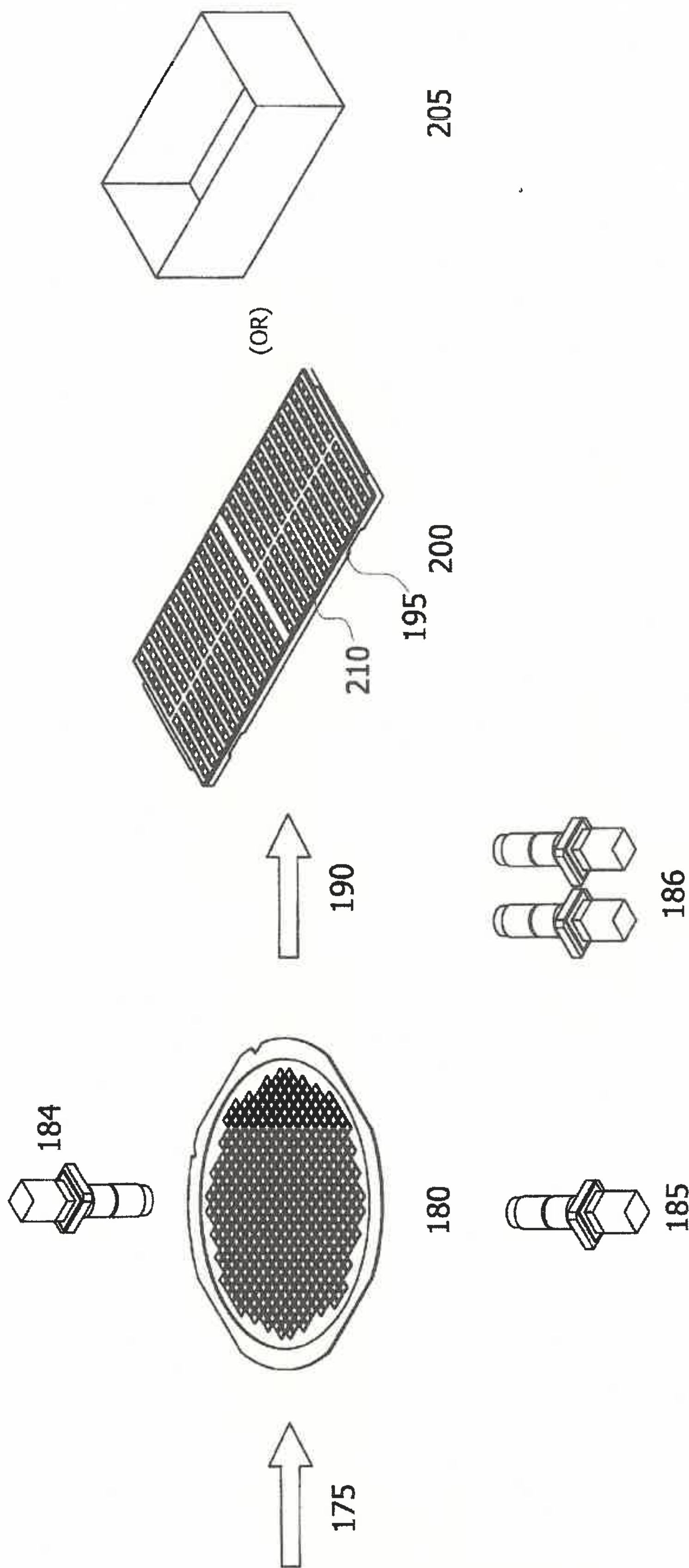

Figure 4

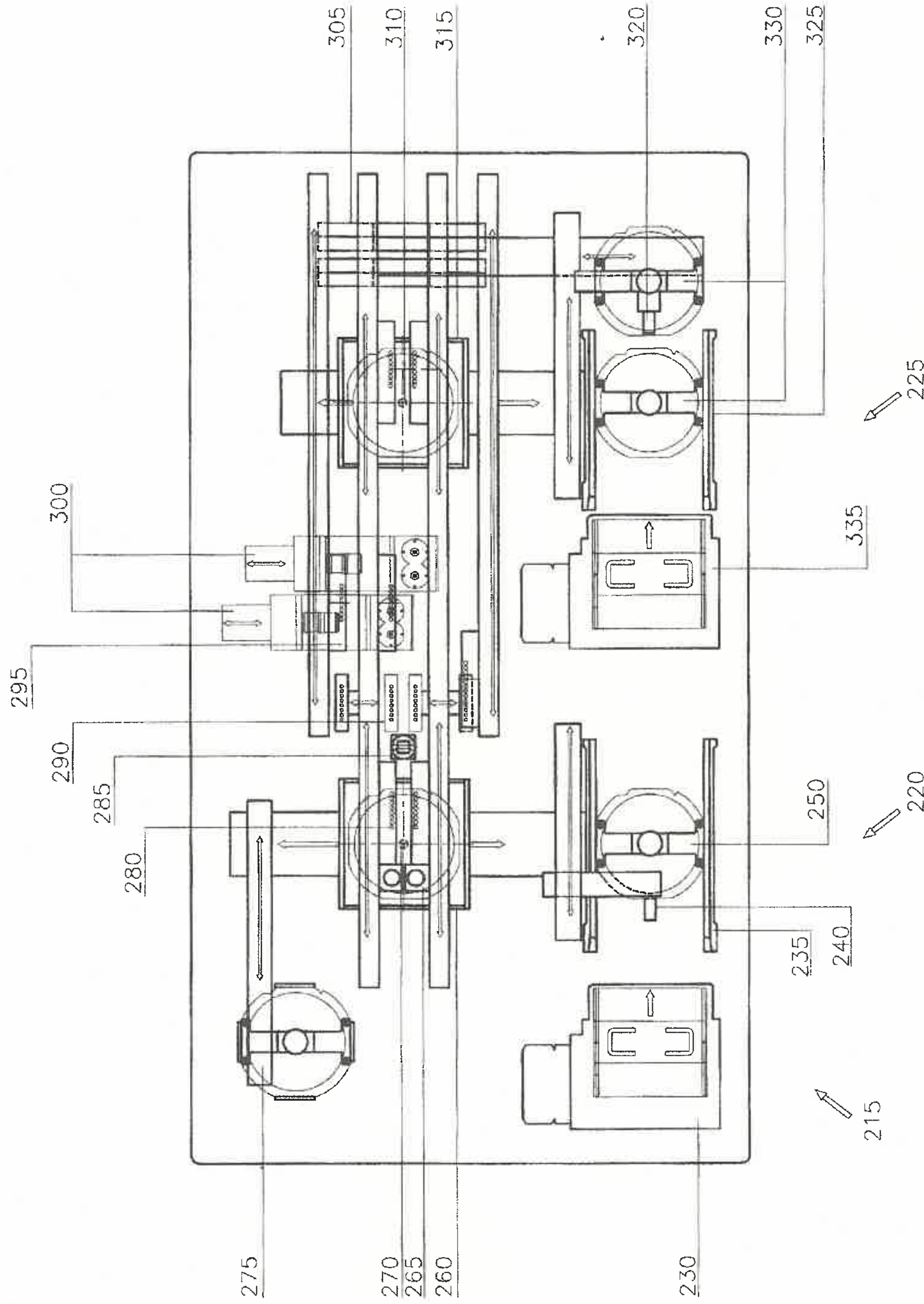

Figure 5

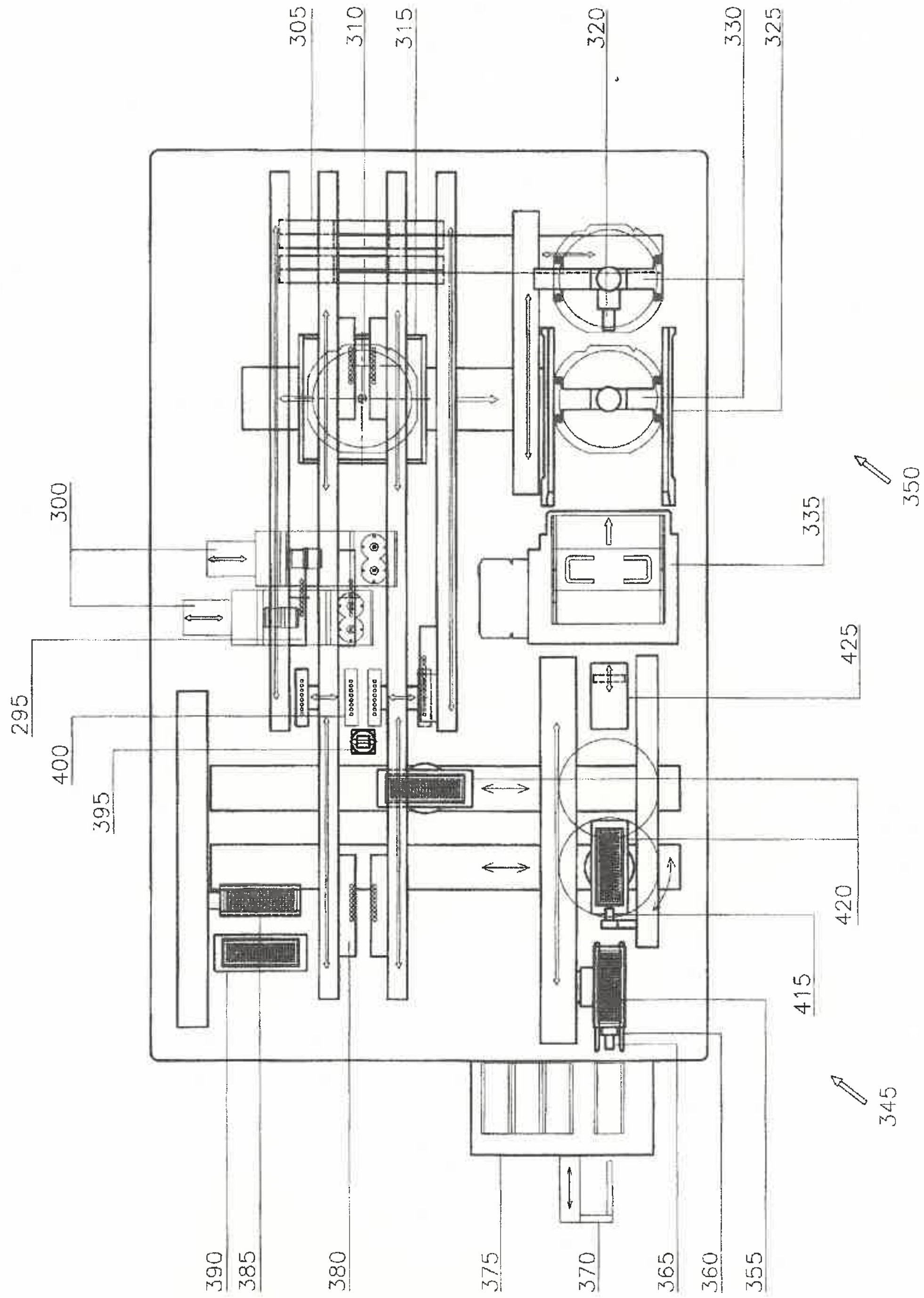

Figure 6

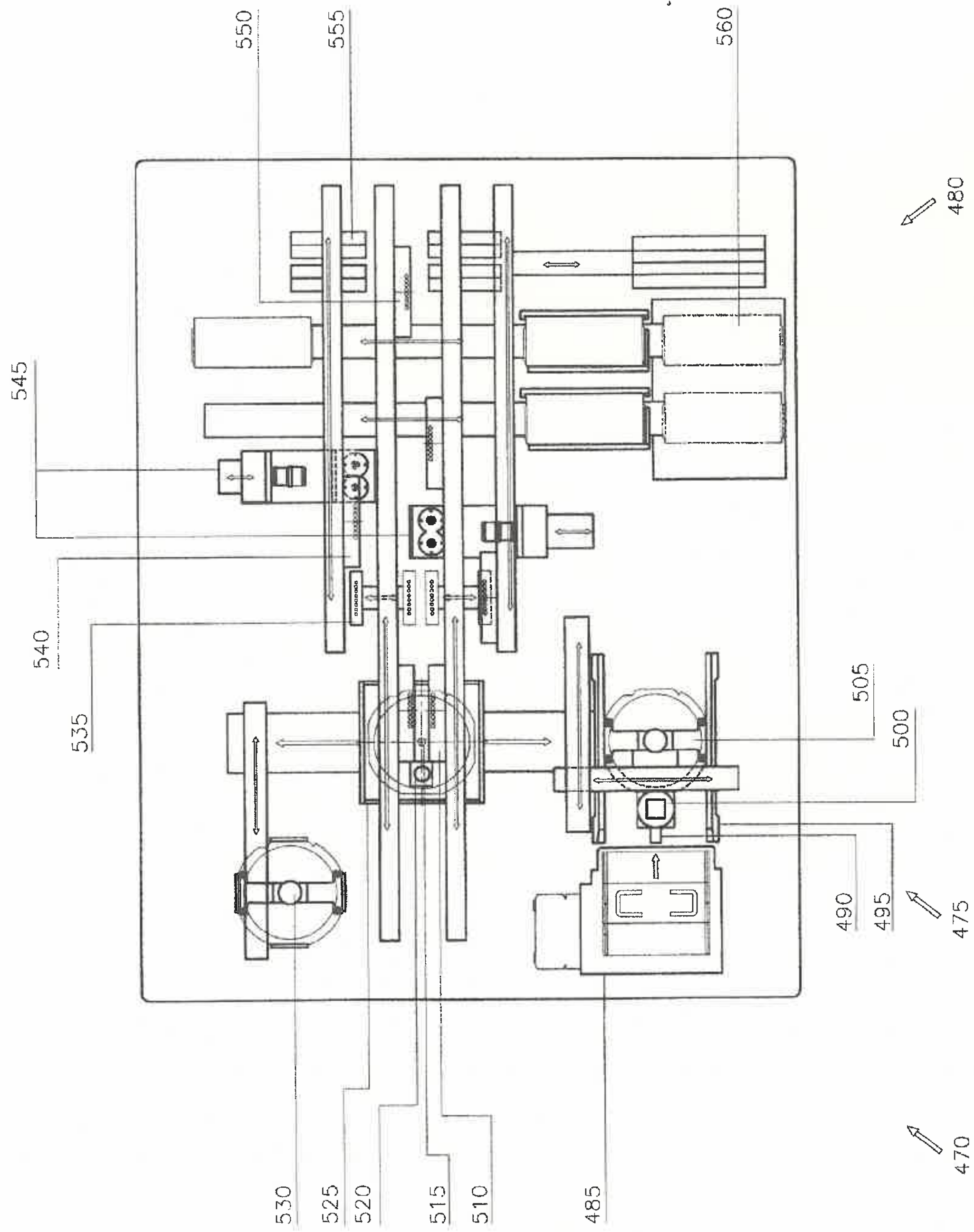

Figure 7

APPARATUS AND METHOD FOR PROCESSING SPUTTERED IC UNITS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a filing under 35 U.S.C. 371 as the National Stage of International Application No. PCT/SG2015/050257, filed Aug. 12, 2015, entitled "APPARATUS AND METHOD FOR PROCESSING SPUTTERED IC UNITS," which claims the benefit of and priority to Singapore Application No. 10201404879U, filed with the Intellectual Property Office of Singapore on Aug. 13, 2014, both of which are incorporated herein by reference in their entirety for all purposes.

FIELD OF THE INVENTION

The invention relates to the processing of IC units following their singulation from a substrate. In particular, the invention relates to processing of said IC units intended for a sputtering process.

BACKGROUND

With the growth in smart phone technology, the pressure for the placement of analog components in close proximity is also growing, and consequently, the requirement for, the elimination of interference from adjacent components. EMI shielding which is used to block noise and electromagnetic interference generated from RF modules is developing as a new technology and is seen as the process of choice in order to overcome these issues.

To this end, components received a sputtered metal coating of a variety of suitable materials providing high electrical conductivity and electromagnetic shielding efficiency. The introduction of the sputtered process for the processing of IC units complicates the manufacturing process by not only introducing a new process but interrupting that process to remove the IC units to a special environment for the application of the sputtered coating.

Further, the arrangement of the IC units in order for the sputtering process to be successful, is contrary to the efficient processing of these units, and so the interruption is not only in the process, but in the handling of the individual units.

SUMMARY OF INVENTION

In a first aspect the invention provides a method for preparing a film carrier for sputtering of IC units placed thereon, the method comprising the steps of: providing a carrier of IC units; removing said units from the carrier; delivering said IC units to a flipper; inverting and delivering said units to a sputtering film frame; placing the units on said sputtering film frame in an array having a pre-determined clearance about adjacent units.

In a second aspect the invention provides a method for re-distributing IC units on a sputtering film frame, the method comprising the steps of: providing the sputtering film frame of sputtered IC units in an array having a pre-determined clearance about adjacent units, and; inspecting the units from below the sputtering film frame; removing said units from the sputtering film frame.

In a third aspect the invention provides a device for preparing a film carrier for sputtering of IC units placed thereon comprising: a loading station for loading a carrier of IC units into said device; a unit picker arranged to remove said units from the carrier and deliver said IC units to a flipper, said flipper arranged to invert said units; wherein said unit picker is arranged to deliver said units from the flipper to a sputtering film frame in an array having a pre-determined clearance about adjacent units.

In a fourth aspect the invention provides a device for re-distributing IC units on a sputtering film frame, the device comprising: a loading station for loading the sputtering film frame of sputtered IC units in an array having a pre-determined clearance about adjacent units into said device; a unit picker arranged to remove said units from the sputtering film frame and; wherein said unit picker is further arranged to place the sputtered units in a tray and a tray picker arranged to deliver the tray to an unloading station.

Accordingly, the invention provides for a preparatory process for the delivery of IC units from a singulation process to an arrangement suitable for sputtering under clean room conditions.

The invention further provides for the conversion of this arrangement in a post-sputtering process to repackage the IC units for delivery to components assembly clients.

BRIEF DESCRIPTION OF DRAWINGS

It will be convenient to further describe the present invention with respect to the accompanying drawings that illustrate possible arrangements of the invention. Other arrangements of the invention are possible and consequently, the particularity of the accompanying drawings is not to be understood as superseding the generality of the preceding description of the invention.

FIG. **1** is a schematic view of a process according to one embodiment of the present invention;

FIG. **2** is a schematic view of a preparatory process according to one embodiment of the present invention;

FIG. **3** is a schematic view of a preparatory process according to a further embodiment of the present invention;

FIG. **4** is a schematic view of a supplementary process according to one embodiment of the present invention;

FIG. **5** is a plan view of a preparatory device according to one embodiment of the present invention;

FIG. **6** is a plan view of a preparatory device according to a further embodiment of the present invention;

FIG. **7** is a plan view of a supplementary device according to a further embodiment of the present invention.

DETAILED DESCRIPTION

FIG. **1** shows a schematic view for the preparation **10**, **15** of IC units prior to sputtering **25** and a supplementary process **20** for packaging the sputtered IC units. Various aspects of the invention relate to each of the preparatory processes **10**, **15** and supplementary process **20**, as well as the overall process **5**.

Looking at the first preparatory process **10** shown in FIG. **2**, a film carrier frame **30** is provided to the process. The units undergo an alignment inspection **35**, and then delivered **40** to a flipper **45** and in the process undergo a mark inspection **35** for checking of fiduciary marks. The units are then inverted and delivered **55** from the flipper **45** to a carrier frame **60**. During the delivery step **55** the units undergo a side vision inspection **50**. The unit picker, during the delivery step **55**, is arranged to place the units onto the carrier frame **60** in an array **65** such that each of the units **70** are separated **75**, **80** by a predetermined spacing. For instance, the spacing **75**, **80** may be in a range 0.5 to 2.0 mm.

The delivery steps **40**, **55** may be achieved by separate unit pickers or alternatively by the same unit picker having a rail spanning from the film carrier frame **30** to the sputtering film frame **60**. The sputtering film frame **60** is then unloaded so as to undergo this sputtering process.

FIG. **3** shows a schematic view of an alternative preparatory process **15**. This process is arranged to receive the IC units in the form of a carrier **90** having the IC units secured through tape **85**. The carrier **90** and tape **85** are delivered **100** to a tape removal unit **105**. A pilot pin type device (not shown) is used for aligning the units between the carrier and tape removal unit **105**.

In order to release the IC units from the carrier **90** the tape **85** is removed by the tape removal unit **105**. Here, a gripper **130** engages the tape whilst a strong vacuum **125** is applied to the units and carrier **90**. A slide **115** to which the gripper **130** is mounted applies a uniform force, peeling the tape from the units **90**. Following removal of the tape **85**, the vision **95** inspects for unit alignment.

As with the process of FIG. **2**, the released units are then delivered **140** to a sputtering film frame **150** passing through a mark inspection **134** and then a side inspection **135** during the delivery step **140** which is performed by a unit picker.

As with FIG. **2** the process **15** of FIG. **3** is arranged such that the unit picker places the released units **160** in a predetermined array **155** having the unit separated **165**, **170** in a predetermined arrangement.

The sputtering film frames **150** are subsequently delivered to the sputtering process (not shown).

FIG. **4** shows a schematic view of a supplementary process **20** whereby sputtering film frames **180** are delivered **175** following the sputtering process. Here the units undergo a mark inspection **184**, followed by an alignment inspection **185**.

The sputtered units are delivered **190** via side inspection **186**. The units are realigned by a precisor (not shown) for placement within a recess **210** of a tray **200**. The units will be inspected on all sides whilst in the tray prior to being offloaded or alternatively placed in a bin **205**.

FIG. **5** shows one embodiment of a preparatory process and in particular a machine layout corresponding to the schematic flow of FIG. **2**.

As shown in FIG. **5**, the machine layout **215** comprises two parts being the unit delivery portion **220** and the unit placement portion **225**. In this particular embodiment the machine layout may be categorized as a film to film process in that it is arranged to receive film frames through a cartridge arrangement via the unloading elevated **230**. Individual frames are engaged by a gripper **240** and brought into the apparatus via a rail **235** whereupon the frame is engaged by a frame picker **250**.

The frame is delivered to a frame removal area by the frame picker **250** whereupon it is placed on a working table **260** and inspected by an alignment inspection camera **265**. The units are removed from the frame by a package picker **280** and delivered to a flipper **290**. During the delivery step, a further mark inspection **285** is carried out.

On removal of the packages to the flipper **290**, the frame is ejected by an ejector **270** and removed by a frame offloader **275**.

Following inversion by the flipper **290**, a sorting picker delivers the unit to a further working table **315** with the units further inspected through a side vision inspection **300** prior to placement in a designated array on a sputtering film frame placed upon a working table **315**. On successful transfer of the units, the sputtering film frame is ejected and carried to an offloading zone whereby the sputtering film frame is gripped **320** and placed within a frame picker **330** whereupon it is delivered along a rail **325** for offloading to a cartridge **335**.

Units not meeting the requirement through any one of the previous inspection zones are placed in a bin **305** for disposal.

The cartridge, now being full of sputtering film frames, having units placed in an array suitable for sputtering can now be delivered to a sputtering process for future processing.

FIG. **6** shows an alternative arrangement whereby the machine layout **340** may be characterized as a carrier to film process.

Again there is a unit delivery zone **345** and a unit placement zone **350**. However, in this arrangement the machine layout **340** has been designed for receiving carriers whereby the singulated units are engaged by a tape rather than film frames for which the units may be readily, removed.

In this arrangement, a cassette magazine loader **375** includes a pusher **370** for inserting the carriers into an inlet rail **360** via a gripper **365**. A carrier loading picker **355** then engages the carrier and delivers this to a tape removal device **415** whereby the units are released by removing the tape. The release carrier is then rotated on a turntable **420** and delivered along a rail whereby the units are delivered to a flipper **400** via a marked visioning inspection **395**. The empty carriers are then unloaded by a picker **385** and placed within an elevator **390** for subsequent disposal.

The unit placement section **350** then follows the same path with the same equipment as that of the unit placement system of FIG. **5**.

Accordingly, the process of FIG. **6** yields a full cartridge **335** for delivery to a sputtering process.

FIG. **7** shows a supplementary process having a machine layout **470**. The machine layout includes a sputtering film frame receiving section **475** and an unloading section **480**.

Following the sputtering process, the cartridge of sputtered film frames **485** is then delivered to an offloading section whereby a gripper **490** grips individual frames and draws them along a rail **495** to be engaged by a frame picker **505**. A mark vision inspection **500** inspects the sputtered units during the delivery phase.

The sputtering film frame is then delivered to a work table **525** whereby a package picker **510** engages the sputtered units for subsequent offloading. An alignment vision inspection **520** adjacent to the ejector **515**, inspects from below the package picker and through the tape, checking the alignment of the units to avoid misalignment of the units. On removal of the units, the frame is ejected by an ejector **515** and removed by a frame offloader **530**. The sputtered units are delivered to a precisor **535** to realign the units into recesses of the module for subsequent placement by a sorting picker **540** into the trays for offloading **560**. The sorting picker passes the sputtered units plus a side vision arrangement **545** and either places the units into a bin **555** or onto further sorting picker **550** for delivery to the tray offloader **560**.

The invention claimed is:

1. A method for preparing a film carrier for sputtering of IC units placed thereon, the method comprising the steps of:

providing a carrier of IC units;

engaging the carrier and IC units with a vacuum;

engaging a tape with a gripper;

sliding the gripper along a slide whilst applying a uniform force to the tape;

peeling the tape from the units, and so detaching the tape from the carrier so as to release said IC units, and then;

inspecting the units for alignment, then;
removing said IC units from the carrier;
delivering said IC units to a flipper;
inverting said IC units;
providing a sputtering film frame for receiving said IC units;
delivering said IC units to the sputtering film frame; and
placing the IC units on said sputtering film frame in an array having a pre-determined clearance about adjacent units.

2. The method according to claim **1**, wherein the removing step precedes a step of ejecting the carrier.

3. The method according to claim **1**, wherein the providing step precedes a step of inspecting the alignment of said IC units on said carrier.

4. The method according to claim **1**, wherein the inverting step precedes a step of performing a second inspection of said inverted IC units.

5. The method according to claim **1**, wherein the placing step precedes a step of conducting a side inspection of the IC units whilst on the sputtering film frame.

* * * * *