Claims

1. A workpiece support assembly for supporting and aligning a plurality of singulated workpieces within a printing machine, the singulated workpieces entering the printing machine on a carrier, the workpiece support assembly comprising an assembly body and a plurality of support members mounted on the assembly body which each support a workpiece in use, each support member comprising:

a base mounted on the assembly body,

a head unit for supporting a workpiece thereon, and

an actuation mechanism for moving the head unit relative to the base,

wherein the actuation mechanism comprises a parallel kinematic system having at least three drive units each directly acting on the head unit, such that the actuation mechanism is selectively operative to move the head unit relative to the base to cause a translation of the head unit parallel to a plane, a rotation of the head unit about an axis orthogonal to that plane, or a combination of said translation and said rotation.

2. The workpiece support assembly of claim 1, wherein each drive unit comprises a coil.

3. The workpiece support assembly of claim 2, wherein each drive unit comprises a linear motor coil; optionally the actuation mechanism comprises three drive units, the linear motor coils of said drive units have non-parallel axes.

4. The workpiece support assembly of claim 2, wherein the coil of each drive unit is wound about a respective winding axis, the winding axes being parallel to each other and orthogonal to the plane.

5. The workpiece support assembly of claim 4, wherein the actuation mechanism comprises four drive units, with at least two of said drive units spaced in a first direction parallel to the plane, and at least two of said drive units spaced in a second direction parallel to the plane, the first and second directions being orthogonal.

6. The workpiece support assembly of ~~any preceding~~ claim 1, wherein the drive units are mounted to the base.

7. The workpiece support assembly of ~~any preceding~~ claim 1, wherein the support member comprises a bearing, optionally an air bearing, located between the base and the head unit.

8. The workpiece support assembly of claim 7, wherein the bearing comprises an air bearing.

9. The workpiece support assembly of claim 1, wherein the actuation mechanism comprises a hexapod.

10~~9~~. The workpiece support assembly of ~~any preceding~~ claim 1, comprising a processor for controlling the actuation mechanism.

11~~10~~. The workpiece support assembly of ~~any preceding~~ claim 1, wherein at least one of the head unit and base comprises at least one encoder which is operative to determine a position of the head unit.

12~~11~~. The workpiece support assembly of ~~any preceding~~ claim 1, wherein the head unit comprises a tooling interface for receiving a tooling module, the tooling module supporting a workpiece thereon in use. ~~; optionally the workpiece is supported parallel to the plane in use.~~

13~~12~~. The workpiece support assembly of ~~any preceding~~ claim 1, wherein the base comprises a port for connection to a vacuum source, the head unit comprises an aperture, and the support member comprises a vacuum path extending between the port and the aperture. ~~aperture; optionally the vacuum path comprises flexible tubing.~~

14~~13~~. The workpiece support assembly of ~~any preceding~~ claim 13 wherein the vacuum path comprises flexible tubing.

15. The workpiece support assembly of claim 1, which is configuredadapted for removable engagement with a printing machine.

1614. A printing machine comprising the workpiece support assembly of any preceding claim 15.

1715. A method of aligning a plurality of singulated workpieces, comprising the steps of:

a) positioning the workpieces over the workpiece support assembly of any of claims 1 to 1513, such that each workpiece overlies a respective support member;

b) lifting the workpiece support assembly so that the support members contact and lift the respective overlying workpieces; and

c) aligning each workpiece individually by operation of the respective actuation mechanisms;.

16. The method of claim 15, wherein each workpiece comprises a fiducial marking, step a) comprises optically detecting each fiducial to determine the orientation and position of the workpieces, and step c) comprises aligning each workpiece individually to a predetermined position by operation of the respective actuation mechanisms in dependence of the determined orientation and position;.

the method further

17. A method of printing a plurality of singulated workpieces, comprising the steps of:

providing the printing machine of claim 14,

aligning the plurality of singulated workpieces using the method of either of claims 15 and 16, and

performing a printing operation on the aligned workpieces.

18. The method of either of claims 16 and 17, comprising an initial step of placing a plurality of workpieces into a carrier, the carrier supporting a peripheral region of each workpiece, (and having an aperture proximate a central portion of each workpiece), and wherein step a) comprises positioning the carrier over the workpiece support assembly, such that each workpiece overlies a respective support member, wherein step b) comprises lifting

the workpiece support assembly so that the support members contact and lift the respective overlying workpieces away from the carrier, and, following completion of the printing operation, the workpieces are lowered into engagement with the carrier, and the carrier is transported from the printing machine.

18. A method of printing a plurality of singulated workpieces, comprising the steps of:

providing a printing machine comprising a workpiece support assembly for supporting and aligning a plurality of singulated workpieces within a printing machine, the singulated workpieces entering the printing machine on a carrier, the workpiece support assembly comprising an assembly body and a plurality of support members mounted on the assembly body which each support a workpiece in use, each support member comprising:

a base mounted on the assembly body,

a head unit for supporting a workpiece thereon, and

an actuation mechanism for moving the head unit relative to the base,

wherein the actuation mechanism comprises a parallel kinematic system having at least three drive units each directly acting on the head unit, such that the actuation mechanism is selectively operative to move the head unit relative to the base to cause a translation of the head unit parallel to a plane, a rotation of the head unit about an axis orthogonal to that plane, or a combination of said translation and said rotation,

wherein the workpiece support assembly is configured for removable engagement with the print machine,

aligning the plurality of singulated workpieces using the method of claim 17, and

performing a printing operation on the aligned workpieces.

19. The workpiece support assembly of claim 3, the actuation mechanism comprises three drive units.