

AN IMPROVED PORTABLE MILLING MACHINE

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FIELD OF INVENTION

The present invention relates to an improved portable apparatus, particularly but not solely, for milling a surface.

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BACKGROUND

Milling machines are among the most versatile and useful machine tools due to their capabilities to perform a variety of operation. In the shipping industry, milling machines are used for ship building and repair works. Where the disassembly and/or removal of components to be machined would be cumbersome, impractical and/or cost-prohibitive, many repair works of structural components are often carried out in-situ, e.g. on board a ship. Most milling machines are very heavy and require cranes or heavy duty hoisting equipment to move. At times, the physical environment for milling a piece of work can also be constrained in a limited and restricted area. Therefore portable milling machines have been developed.

JP 07-266118 (Tadao) et al describes a portable milling device that is able to be carried into a site to perform a milling work. The milling machine is mounted on a frame which allows the milling machine to be moved in the

horizontal direction by a moving means, for example comprising of a caster. Further the frame can be moved vertically by a jack, and a further fixing means comprising of a magnet or the like is provided on the frame for fixing the work to the frame when the milling machine is lowered together with the frame by
5 the jack.

US patent no. 5,533,845 (Glover) describes a portable milling machine that can be used for in-situ milling. The portable milling machine comprises a cutting head, a control mechanism and a power supply where the cutting head
10 generally includes a frame for securing the device to a work piece and the frame is movable (using alignment wheels) relative to a sub frame about x and y axes either manually or automatically by a conventional pneumatic or hydraulic movement mechanism manipulated by hand or computer control.

15 US patent no. 5,152,643 (McGettigan) describes a method and apparatus for milling a flat surface on a large scale assembly, such as the horizontal joint surface of the outer structure of a steam turbine. The apparatus comprises lateral and longitudinal drive means installed on a lower base assembly which is specifically adapted to be mounted and leveled by engaging portions of the
20 structure to be machined. Sliding platforms are engaged with drive means, and a milling head is mounted to the platforms to provide the capability to move the milling head both laterally and longitudinally across the surface to be machined via lateral and longitudinal rails respectively. The milling head is affixed to a platform that permits indexing the milling head to a position where it may
25 extend beyond the maximum travel of the drive means and thereby machine the corners or inaccessible areas of the structure. This patent broadly describes

apparatus for milling a flat surface on a structure the apparatus including at least a base adapted to engage the structure, a milling head and a platform for supporting the milling head. The platform is supported by a first drive means for moving the platform along a first axis and a second drive means for moving
5 the platform along a second axis, the second axis being perpendicular to the first.

A further portable machine tool is disclosed in US patent no. 5,106,243 (Hunt et al) wherein the portable machine tool includes a bed plate and a
10 cantilevered ram for mounting to a piece of work. A dovetail slide on a side of the ram movably supports a rotatable spindle unit capable of machining in the transverse direction completely crossways of the bed.

In US patent no. 4,022,106 (Kile), a machine tool includes a bed for
15 securing a work piece in place with a fastening means such as C-clamps. A carriage is slidably mounted on the bed ways and includes its own feed arrangement for movement of a carriage mounted column assembly. The column assembly, in addition to moving along perpendicular axes, may be positioned about its lengthwise axis. Entrained on column ways is a slide
20 positioned by a column feed arrangement, the slide in turn rotatably supporting a powerhead assembly within which a cutter or boring tool is carried. This machine can be used for machining large sized work pieces, and machining operations can be initiated using manual or automatic feeds.

25 Also disclosed, in US patent no. 5,032,051 (Gilmore), is a portable milling machine for use in solving in-place machining problems encountered

on turbines, pumps, motor bases, and other types of field equipment requiring a close tolerance, machined surface prior to installation. Such portable milling machine is set up at the job-site. The adjustment of the machine can be attained along each of the conventional x, y and z axes.

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It is an object of the present invention to provide a portable milling machine that can accurately position a machining tool over a relatively large area.

10 **SUMMARY OF INVENTION**

The current invention may be broadly said to be a portable milling machine adapted to be supported in use by attachment to a work piece, the milling machine comprising:

15 a base comprising spaced apart first and second guideways and spaced apart first and second base members, the first and second guideways each extending parallel to a first direction and spanning between respective ends of the first and second base members, and the first and second guideways and the first and second base members being assembled together to form a closed
20 perimeter about an open area;

a first carriage moveably supported on the first and second guideways for movement of the first carriage parallel to the first direction, the first carriage including spaced apart third and fourth guideways each extending parallel to a second direction, the second direction being not parallel to the first direction;
25 and

a second carriage moveably supported on the third and fourth guideways for movement of the second carriage parallel to the second direction, the second carriage carrying a milling tool,

wherein the milling tool can be selectively positioned at a plurality of
5 locations within the open area by said movements of the first and second carriages.

Preferably, the second carriage carries the milling tool between the third and fourth guideways.

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Preferably, the first direction is substantially perpendicular to the second direction.

Preferably, the milling tool is rotatable about an axis that is perpendicular to the
15 first and second directions.

The milling machine may include attachment means by which the portable milling machine can be secured to the work piece. The attachment means may be a plurality of clamps, and may include at least one C-clamp, G-clamp or
20 magnetic clamp.

The milling machine may include adjustment means, for example a plurality of threaded adjustment screws, by which the position of the portable milling machine relative to the work piece can be adjusted.

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BRIEF DESCRIPTION OF DRAWINGS

Preferred embodiments and methods of utilizing the invention will be further described, with reference to the corresponding figures, by way of examples only and without intending to be limiting, wherein;

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Figure 1 shows a side view of a portable milling machine according to a preferred embodiment of the invention mounted to a work piece,

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Figure 2 shows a plan view of the portable milling machine of Figure 1, and

Figure 3 shows a front view of the portable milling machine of Figures 1 and 2 mounted to a work piece.

15 **DETAILED DESCRIPTION**

The following description of a preferred embodiment of the invention is given by way of example only.

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Figure 1 shows an improved milling machine 2 mounted to a work piece. In the figures, the work piece is a main engine seating girder 16. The milling machine is positioned with reference to a stainless steel shim 18. The milling machine 2 comprises a milling cutter 4 which is powered by an electric motor 6. The milling machine 2 can also be powered by other suitable means, for
25 example a hydraulic or pneumatic motor.

The milling machine 2 has a base 20 comprising two mutually parallel and spaced apart transverse guideways or rails 10 and two spaced apart longitudinal base members. The two guideways 10 span between, and are fixed to ends of, the two base members to form a closed perimeter about an open area. The open area allows a portion of an underlying work piece, such as the girder 16, to be exposed to the milling cutter 4 which can be moved within the area. In the preferred embodiment shown in the figures, the transverse guideways and longitudinal base members are arranged in a rectangular configuration.

10 A first carriage 8 is moveably supported on the two transverse guideways 10. The first carriage engages a lead screw mounted in the base 20. The lead screw is rotated, such as by manually turning a handle, to move the carriage parallel to the transverse guideways 10 along a first axis. Alternatively, the lead screw can be rotated by a motorized drive system (not shown), under
15 either manual or automatic control.

The first carriage 8 carries a longitudinal rail system 8 comprising two parallel guideways or rails which are parallel to a second axis. The first and second axes are not parallel and in the preferred embodiment, and as shown in
20 the figures, are preferably perpendicular to one another.

A second carriage carrying a milling tool 4 and its drive motor 6 is moveably supported on the two guideways of the longitudinal rail system 8. The second carriage is moved along the longitudinal guideways 10 parallel to
25 the second axis. A carriage drive system 22 is used to control the movement of the second carriage along the second axis. This carriage drive system may

include a carriage drive motor which can be controlled automatically to advance the second carriage along the longitudinal guideways.

5 The base 20 which includes the transverse rail system 10, and which supports the longitudinal rail system 8, is secured to an engine girder 16, preferably by a clamp, for example a C or G clamp 12. The longitudinal rail system 8 is aligned along the first axis in a different direction from the second axis of the transverse rail system 10. Preferably, the axes are aligned perpendicular to one another, for example along x-y axes. The height of the transverse and longitudinal rail systems is adjustable relative to the engine
10 girder 16, or other work piece to which the milling machine is attached, by means of height control bolts 14.

The milling machine performs consistently and applies a uniform milling
15 action that can produce a surface finish of roughness 1.6. The portable milling machine is attached to a work piece to machine to an improved surface finish or accuracy over a larger surface area before requiring repositioning of the milling machine on the work piece. This is possible because the milling tool remains inside the confines of the base with the milling tool supported between the two longitudinal guideways and between the two transverse guideways. The milling
20 tool of the current invention does not need to be cantilevered beyond the guideways as in the prior art, thus allowing an improved accuracy and surface finish.

List of features labeled in the figures

	Milling machine	-	2
5	Milling cutter	-	4
	Electric Motor	-	6
	Longitudinal rail system	-	8
	Manual transverse rail system	-	10
	C or G Clamp	-	12
10	Height control bolt	-	14
	Engine girder	-	16
	Stainless steel shim	-	18
	Base	-	20
	Carriage drive system	-	22

CLAIMS:

5 1. A portable milling machine adapted to be supported in use by attachment to a work piece, the milling machine comprising:

 a base comprising spaced apart first and second guideways and spaced apart first and second base members, the first and second guideways each extending parallel to a first direction and spanning between respective ends
10 of the first and second base members, and the first and second guideways and the first and second base members being assembled together to form a closed perimeter about an open area;

 a first carriage moveably supported on the first and second guideways for movement of the first carriage parallel to the first direction, the first
15 carriage including spaced apart third and fourth guideways each extending parallel to a second direction, the second direction being not parallel to the first direction; and

 a second carriage moveably supported on the third and fourth guideways for movement of the second carriage parallel to the second direction, the
20 second carriage carrying a milling tool,

 wherein the milling tool can be selectively positioned at a plurality of locations within the open area by said movements of the first and second carriages.

25 2. A portable milling machine as claimed in claim 1, wherein the second carriage carries the milling tool between the third and fourth guideways.

3. A portable milling machine as claimed in claim 1 or 2, wherein the first direction is substantially perpendicular to the second direction.
- 5 4. A portable milling machine as claimed in claim 1, 2 or 3, wherein the milling tool is rotatable about an axis that is perpendicular to the first and second directions.
- 10 5. A portable milling machine as claimed in any one of the preceding claims, wherein the milling machine includes attachment means by which the portable milling machine can be secured to the work piece.
- 15 6. A portable milling machine as claimed in claim 5, wherein the attachment means is a plurality of clamps.
- 20 7. A portable milling machine as claimed in claim 6, wherein the attachment means includes at least one C-clamp, G-clamp or magnetic clamp.
- 25 8. A portable milling machine as claimed in any one of the preceding claims, wherein the milling machine includes adjustment means by which the position of the portable milling machine relative to the work piece can be adjusted.
9. A portable milling machine as claimed in claim 8, wherein the adjustment means is a plurality of threaded adjustment screws.