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(54) Title: APPARATUS FOR SURFACE ABRASION

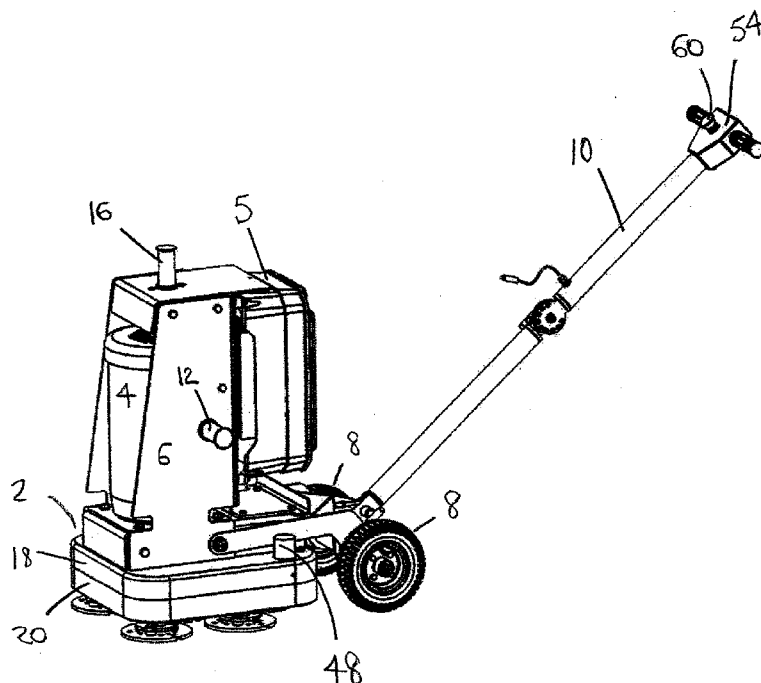


FIG. 1

(57) Abstract: There is provided a sur-
face abrasion apparatus featuring over-
lapping abrasion paths to prevent tool-
ing marks; a spaced housing, aluminum
monocoque motor design and vacuum
venturi to prevent overheating of the
apparatus during operation; positioning
of the tool plates to allow abrasion ad-
jacent a vertical wall; O-ring seals to al-
low operation in wet conditions; mag-
netic and hook and fastener attachment
of tool segments to allow ease of tool-
ing; and articulation of the handle to
permit greater operability.



(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,

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APPARATUS FOR SURFACE ABRASION

FIELD OF THE INVENTION

The present invention relates to construction tools. In particular, the present invention
5 relates to devices for resurfacing through abrasion.

BACKGROUND OF THE INVENTION

It is common for home and business owners, developers, and renovators to wish to renew
a horizontal surface such as a floor, deck, patio or other indoor or outdoor surface. One
10 means of performing such renewal is to abrade the upper surface of the existing material
to provide a newly revealed, cleaner surface, or to prepare the surface for installation
thereon of another surface material.

Various grinding machines for performing surface abrasion are well known in the prior
art. Such prior art machines, however, have several drawbacks. Some are limited in the
15 type of power supply they may employ. Others leave undesirable tooling marks in the
surface, or fail to abrade the surface sufficiently close to adjoining walls. Still others may
overheat and require frequent cooling periods, or may be difficult to service.

SUMMARY OF THE INVENTION

20 There is provided an apparatus for abrading a surface, the apparatus comprising a chassis;
an upper chassis plate attached to the chassis and a corresponding lower chassis plate
attached to the upper chassis plate, the upper and lower chassis plates having a common
outer perimeter; a plurality of aligned openings through the upper and lower chassis
plates, the openings forming an array; a motor attached to the chassis above the chassis
25 plates; a variable frequency drive attached to the motor; sealing means for preventing
entry of fluid into the motor; a plurality of tool plate assemblies, each assembly
comprising a drive shaft extending from the variable frequency drive through a pulley
and an opening in the chassis plates to a tool holder connected to the drive shaft below

the lower chassis plate, a tool plate connectable to the tool holder, and a plurality of tool segments connectable by tool segment attachment means to the lower side of the tool plate, each tool segment having abrasion means on its lower surface and attachment means on its upper surface; a pair of idler pulleys, each pulley positioned between the
5 upper and lower chassis plates in alignment with a corresponding idler opening passing through the upper and lower chassis plates; a drive belt wound adjacent each of the pulleys and idler pulleys; a framework attached to the chassis and surrounding the motor; at least one pair of wheels attached to the chassis; at least one weight post extending from the framework; an elongated handle extending from the chassis; control means for
10 controlling the motor; and a pair of vacuum venturi disposed on opposing first and second sides of the chassis.

The apparatus may further comprise a vacuum pipe attachable to each of the vacuum venturi for connection to a vacuum for removal of heated air and debris. A cooling space may be provided between the inside of the framework and the outer sides of the motor.

15 The motor may be constructed as an aluminum monocoque. There may be a pair of opposing first and second weight posts extending horizontally from opposing sides of the framework, and a third weight post extending vertically from the top of the framework. Each weight post may be adapted to receive a one or more weights of any desired mass.

The array may position the plurality of tool plates in a pattern in which the area abraded
20 by each tool plate as the apparatus is moved during abrasion of a surface is partially overlapped by the area abraded by at least one other tool plate. There may be six tool plate assemblies. The array may position the outside edge of five of the six tool plates adjacent the outer perimeter of the chassis plates.

The sealing means may comprise a plurality of O-ring seals, or other non-liquid sealing
25 means. The tool segment attachment means may comprise one or more magnets, or a hook and fastener attachment system. The handle may have one or more articulations.

BRIEF DESCRIPTION OF THE DRAWINGS

In drawings which illustrate by way of example only specific embodiments of the invention:

Fig. 1 is a perspective view of an apparatus for surface abrasion according to one
5 embodiment of the invention;

Fig. 2 is a bottom plan view of the apparatus, showing the positioning of the tool plate array;

Fig. 3 is a view of the machine chassis with one side of the chassis lifted away;

Fig. 4 shows a bottom plan view of a symmetrical tool plate, a side plan view of a tool
10 holder attached to a tool plate, and a perspective view of a tool plate with two tool segments;

Fig. 5 shows a bottom perspective view of a tool holder, a tool plate having a hook and loop fastener backing, and a tool plate with associated fastening magnets;

Fig. 6 depicts a vacuum venturi in the machine chassis, and the vacuum pipe insertable
15 therein;

Fig. 7 shows a front perspective view of the apparatus of the invention with attached weight plates;

Fig. 8 shows the hand grips and control panel of the apparatus;

Fig. 9 indicates the articulation points of the handle of the apparatus;

20 Fig. 10 shows the apparatus in storage position with the handle folded over the top of the housing; and

Fig. 11 depicts a perspective view of the body of the apparatus showing the variable frequency drive attached to the motor.

25 DESCRIPTION OF THE INVENTION

According to a preferred embodiment of the present invention, there is provided an apparatus for abrading a surface.

As may be seen in the figures, the apparatus of the present invention comprises a machine chassis 2 having a motor 4 attached thereon. A variable frequency drive 5 is connected to the motor, and a framework 6 surrounds the motor. A pair of wheels 8 is connected to the framework to permit rolling transport of the apparatus. An elongated handle 10
5 extends upwardly from the chassis. A pair of opposing weight posts 12, 14 extends horizontally from opposing sides of the framework. A third weight post 16 extends vertically from the top of the framework.

The machine chassis comprises upper and lower chassis plates 18, 20 having paired openings 22 for insertion of tool plates 24, input shafts 26 and pulleys 28. Preferably, an
10 even number of tool assemblies are disposed within an array of an equal number of openings in the chassis. Idler pulleys 32 occupy two additional openings 34 in the machine chassis. Finally, a pair of vacuum venturi 36 is disposed on opposing sides of the machine chassis.

In the preferred embodiment, an even number of openings are spaced within the chassis
15 plates in an alignment which permits a desired overlap 38 between the abrasion area of adjacent tool plates, as shown in Fig. 2. This layout is arranged such that there are rows of tooling heads that overlap each other from side to side in a calculated ratio to provide a cutting path that has an even and level tool path profile. Referring to Fig. 3, rotation of the circular symmetrical tool plates is effected by driving in a forward or reverse
20 direction an input shaft to effect rotation of a belt 40 interwoven among the pulleys of the tool assemblies, thereby rotating the tool assemblies clockwise or counter-clockwise.

With reference to Fig. 4, each tool assembly 42 comprises a tool holder 44 disposed on the lower side of the machine chassis, adapted to receive a tool plate 24, and a plurality of tool segments 46 adapted to engage with the tool plate. The tool plate includes a central
25 input shaft which extends upwardly through a pulley within the machine chassis. The positioning of the openings of the drive train system of the apparatus is designed to ensure that the tool plates extend fully to the outer edge of the apparatus to permit abrasion immediately adjacent a vertical surface such as a wall.

Referring to Fig. 5, various means of attachment of each tool plate to a corresponding tool holder are possible. These means may include the use of magnets 48 or hook and loop fasteners (not shown).

To minimize overheating, the drive system of the present invention is of an aluminum monocoque design. This drive train is assembled within two aluminum billet halves that
5 allow for improved heat dissipation, thus improving the longevity of the enclosed drive components by pulling away undesirable heat from the ball bearings and belt system. Two vacuum ports pass through the drive train to further improve heat dissipation.

As shown in Fig. 6, in addition, a pair of replaceable vacuum pipes 48 may be disposed
10 within vacuum venturi on opposing sides of the machine chassis to permit vacuum removal of generated heat, along with debris abraded from the surface being worked upon. A further cooling aspect comprises the placement of the framework a spaced distance 50 from the motor to permit free flow of air around the motor.

In order to increase the degree of abrasion of a surface, weights 52 may be added to the
15 apparatus. As shown in Fig. 7, one or more individual weights may be added to each of the top and side weight posts to achieve a desired total added weight. The apparatus weight system permits variable weight positions to customize the weight balance and grinding characteristics to allow a user to define selected point pressure bias depending on the shape or profile of the surface needing grinding. The apparatus is designed to
20 accept non-proprietary weights thereby allowing the user to add common Olympic-sized weights of varying sizes and weights. Most prior art devices require use of proprietary weights.

As depicted in Fig. 8, at the upper end of the handle of the apparatus, there is provided a perpendicular crossbar having opposing hand grips, separated by a control panel 54. The
25 control panel may include a forward motion switch 56, a reverse motion switch 58, and an emergency stop switch 60.

Referring now to Figs. 9 and 10, to permit operation in a variety of circumstances, the handle of the present invention is provided with a plurality of articulation points 62 along its length. Adjustment of handle articulation at these points permits easier
30 manoeuvrability of the apparatus. In addition, the handle may thereby be folded over the

framework of the apparatus for compact storage and transport. Handle articulations in multiple locations allowing the machine to be operated in tight quarters, backwards, and under height restricted areas.

Referring to Fig. 11, the apparatus of the present invention is outfitted with a customized
5 variable frequency drive ("VFD") 5 that allows users to use either single or three-phase power sources and to employ variable speed control. VFD also permits current-limiting to suppress current surges and to limit current to a desired maximum as defined within the VFD's programmable parameters.

The tool plate system is adapted to accept standard tooling which has been modified to
10 allow for quick tool changes. The current method for mounting tooling is by fastening tooling directly to the tool plate and requires unfastening to change tools. The new design of the present invention permits use of a magnetic interface to make tool changes faster and easier. Each tool plate has a symmetrical mounting pattern which provides a consistent tool motion to result in a desired abrasion pattern.

15 In operation, the motor, typically electric, variably drives an input shaft in a forward direction, clockwise or counter-clockwise. The input shaft causes a drive pulley to rotate, thereby rotating the drive belt, which in turn rotates each of the tool assembly pulleys and their associated tool plates, to which tool segments are attached. A user moves the apparatus around the surface being abraded to achieve a renewed surface. The motor
20 may also be operated in a reverse direction to effect rotation of the pulleys, belt and tool plates in the opposite direction. A pair of idler pulleys redirects the drive belt around adjacent pulleys.

The apparatus includes a plurality of tool plates, each adapted to receive modified tool segments, which have an abrasive media bonded to their lower surface. The modified
25 tool segments are held in place by the magnet of the tool plate in the preferred embodiment. In an alternate embodiment, the tool plate may have a hook and loop fastener for attachment of abrasive media having a hook and loop fastener interface. The apparatus further includes a plurality of pulleys, each pulley being adapted to rotate a corresponding tool plate; and a plurality of drive shafts in continuous contact with the
30 pulleys via the drive belt such that the tool plates rotate in one direction when the forward

drive shaft is engaged, and in the opposite direction when the reverse drive shaft is engaged.

A control interface for the machine allows for both forward and backward tool rotation which allows the user to re-dress tooling without having to remove the tooling from the machine. The symmetrical design of the drive train system permits operation in forward
5 or reverse direction without incident or impact on machine service factor.

The drive train system of the apparatus is designed to be easily assembled and serviced in the field by an individual with basic mechanical skills. Unlike prior art machines that need to be sent to a repair facility, this drive train can be fully disassembled and re-
10 assembled in approximately 20 minutes with a simple tools and without the use of liquid silicone-type sealers, as the drive train has o-ring seals. The drive train system of the present apparatus is fully sealed and water tight to prevent ingress of foreign debris and other contaminants, including water. This allows for the machine to be used in both wet and dry conditions.

15 The vacuum system of the invention has removable vacuum interface pipes on the upper side of the machine chassis to allow use of inserts of different sizes for vacuum hoses of varying sizes. The vacuum system also incorporates twin flare type openings at the bottom of the drive train which provides a venturi effect to maximize particulate extraction.

20 The tool plate driver allows for multiple tool plate options that can be easily installed and removed by a simple pull. The tool plate driver system also has the ability to accept various densities of rubber to further expand the machines grinding capability by offering varying degrees of articulation.

While specific embodiments of the invention have been described and illustrated, such
25 embodiments should be considered illustrative of the invention only. The invention may include variants not described or illustrated herein in detail. Thus, the embodiments described and illustrated herein should not be considered to limit the invention as construed in accordance with the accompanying claims.

CLAIMS

1. An apparatus for abrading a surface, the apparatus comprising:
 - a machine chassis comprising an upper chassis plate and a corresponding lower chassis plate, the upper and lower chassis plates having a common outer
 - 5 perimeter;
 - a plurality of aligned openings through the upper and lower chassis plates, the openings forming an array;
 - a motor attached above the machine chassis;
 - a variable frequency drive attached to the motor;
 - 10 sealing means for preventing entry of fluid into the motor;
 - a plurality of tool plate assemblies, each assembly comprising an input shaft extending through a pulley and an opening in the chassis plates to a tool holder connected to the input shaft below the lower chassis plate, a tool plate connectable to the tool holder, and a plurality of tool segments connectable by tool segment
 - 15 attachment means to the lower side of the tool plate, each tool segment having abrasion means on its lower surface and attachment means on its upper surface;
 - a pair of idler pulleys, each pulley positioned between the upper and lower chassis plates in alignment with a corresponding idler opening passing through the upper and lower chassis plates;
 - 20 a drive belt wound adjacent each of the pulleys and idler pulleys;
 - a framework attached to the machine chassis and surrounding the motor;
 - at least one pair of wheels attached to the framework;
 - at least one weight post extending from the framework;

an elongated handle extending from the apparatus;

control means for controlling the motor; and

a pair of vacuum venturi disposed on opposing first and second sides of the chassis.

- 5 2. The apparatus of claim 1, further comprising a vacuum pipe attachable to each of the vacuum venturi for connection to a vacuum for removal of heated air and debris.
3. The apparatus of claim 1, wherein a cooling space is provided between the inside of the framework and the outer sides of the motor.
- 10 4. The apparatus of claim 1, wherein the motor is constructed as an aluminum monocoque.
5. The apparatus of claim 1, wherein the at least one weight post comprises a pair of opposing first and second weight posts extending horizontally from opposing sides of the framework.
- 15 6. The apparatus of claim 5, further comprising a third weight post extending vertically from the top of the framework.
7. The apparatus of claim 6, wherein each weight post is adapted to receive a one or more weights of any desired mass.
8. The apparatus of claim 1, wherein the array positions the plurality of tool plates in
20 pattern in which the area abraded by each tool plate as the apparatus is moved during abrasion of a surface is partially overlapped by the area abraded by at least one other tool plate.
9. The apparatus of claim 1, wherein the plurality of tool plate assemblies comprises six tool plate assemblies.

10. The apparatus of claim 9, wherein the array positions the outside edge of a plurality of tool plates adjacent the outer perimeter of the chassis plates.
11. The apparatus of claim 10, wherein the plurality of tool plates comprises five of six tool plates.
- 5 12. The apparatus of claim 1, wherein the sealing means comprises a plurality of O-ring seals.
13. The apparatus of claim 1, wherein the sealing means comprises only non-liquid sealing means.
14. The apparatus of claim 1, wherein the tool segment attachment means comprises
10 one or more magnets.
15. The apparatus of claim 1, wherein the tool segment attachment means comprises hook and loop fastener means.
16. The apparatus of claim 1, wherein each weight post is adapted to receive a plurality of weights of varying sizes.
- 15 17. The apparatus of claim 1, wherein the handle further comprises one or more articulations.
18. An apparatus for abrading a surface, the apparatus comprising:

a machine chassis comprising an upper chassis plate and a corresponding lower chassis plate, the upper and lower chassis plates having a common outer
20 perimeter;

a plurality of aligned openings through the upper and lower chassis plates, the openings forming an array;

an aluminum monocoque motor attached to the chassis above the chassis plates;

a variable frequency drive attached to the motor;

O-ring sealing means for preventing entry of fluid into the motor;

5 six tool plate assemblies, each assembly comprising an input shaft extending through a pulley and an opening in the chassis plates to a tool holder connected to the input shaft below the lower chassis plate, a tool plate connectable to the tool holder, and a plurality of tool segments connectable by tool segment attachment means to the lower side of the tool plate, each tool segment having abrasion means on its lower surface and magnetic attachment means on its upper surface wherein the array positions the plurality of tool plates in a pattern in which the area abraded by each tool plate as the apparatus is moved during abrasion of a surface is partially overlapped by the area abraded by at least one other tool plate and the outside edge of five of the six tool plates is adjacent the outer perimeter of the chassis plates ;

10

a pair of idler pulleys, each pulley positioned between the upper and lower chassis plates in alignment with a corresponding idler opening passing through the upper and lower chassis plates;

15

a drive belt wound adjacent each of the pulleys and idler pulleys;

a framework attached to the machine chassis and surrounding the motor wherein a cooling space is provided between the inside of the framework and the outer sides of the motor;

20 at least one pair of wheels attached to the chassis;

a pair of opposing first and second weight posts extending horizontally from opposing sides of the framework and a third weight post extending vertically from the top of the framework wherein each weight post is adapted to receive a one or more weights of any desired mass;

25 an elongated articulated handle;

control means for controlling the motor;

a pair of vacuum venturi disposed on opposing first and second sides of the machine chassis; and

a vacuum pipe attachable to each of the vacuum venturi for connection to a vacuum for removal of heated air and debris.

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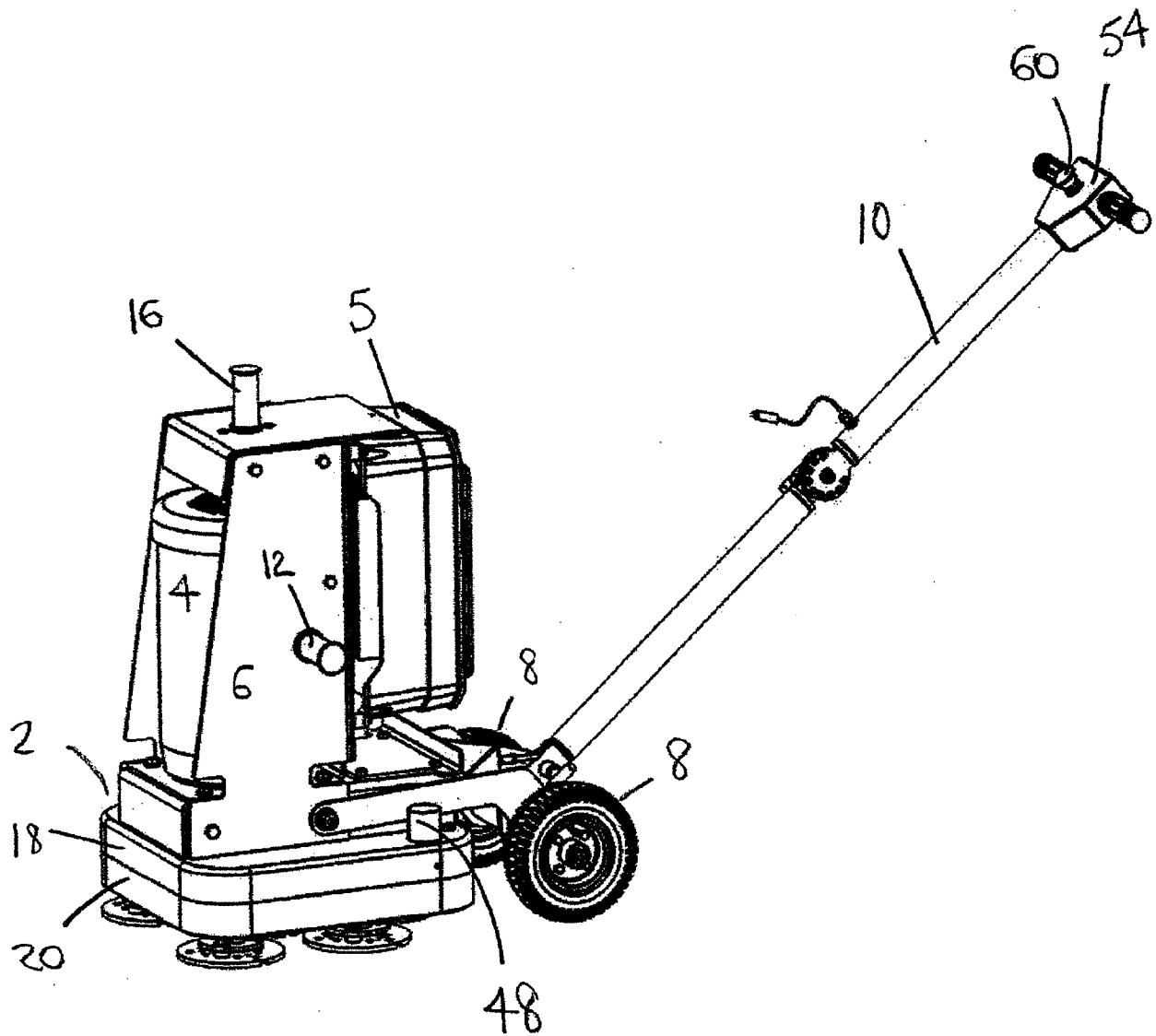


FIG. 1

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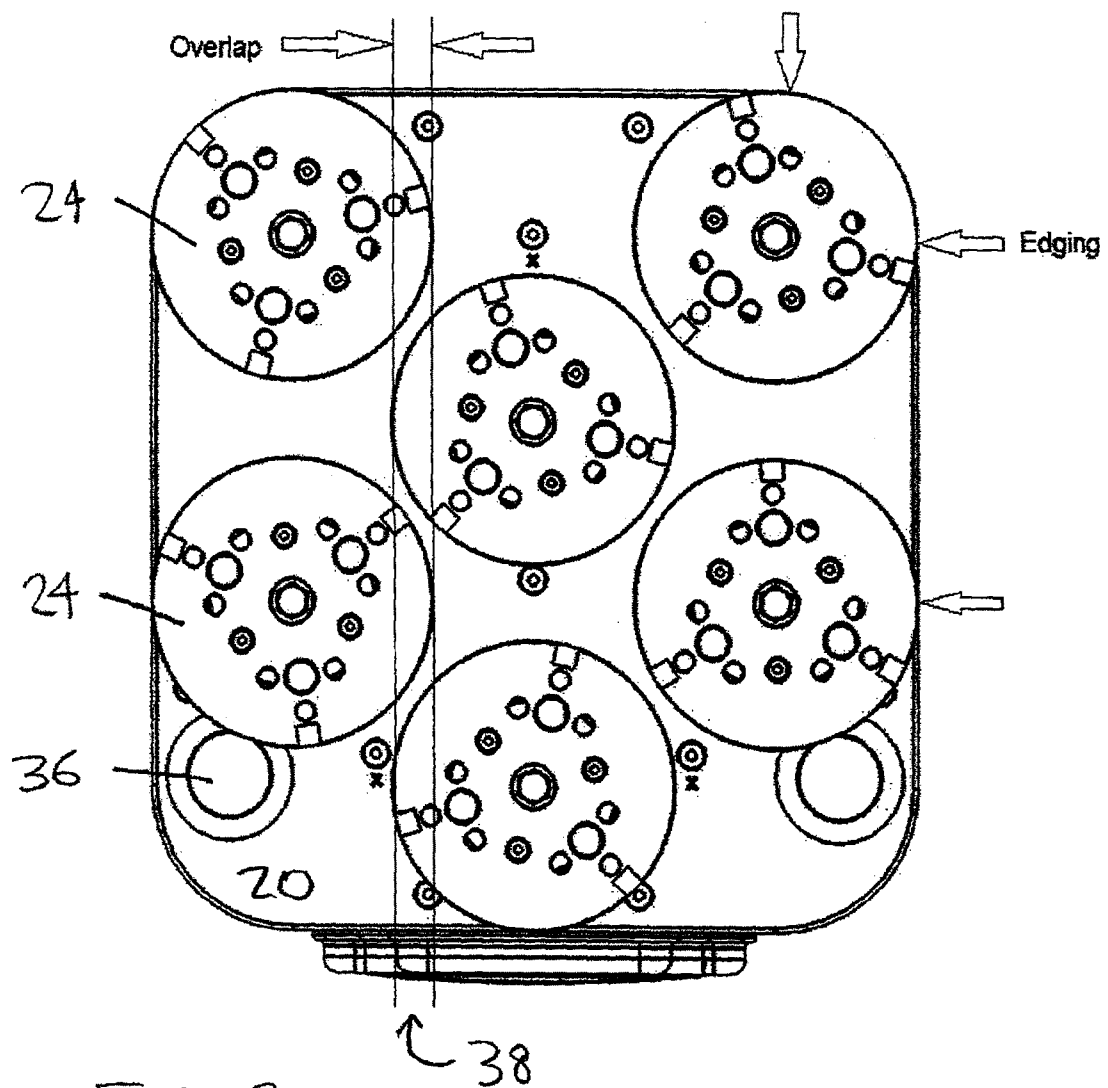
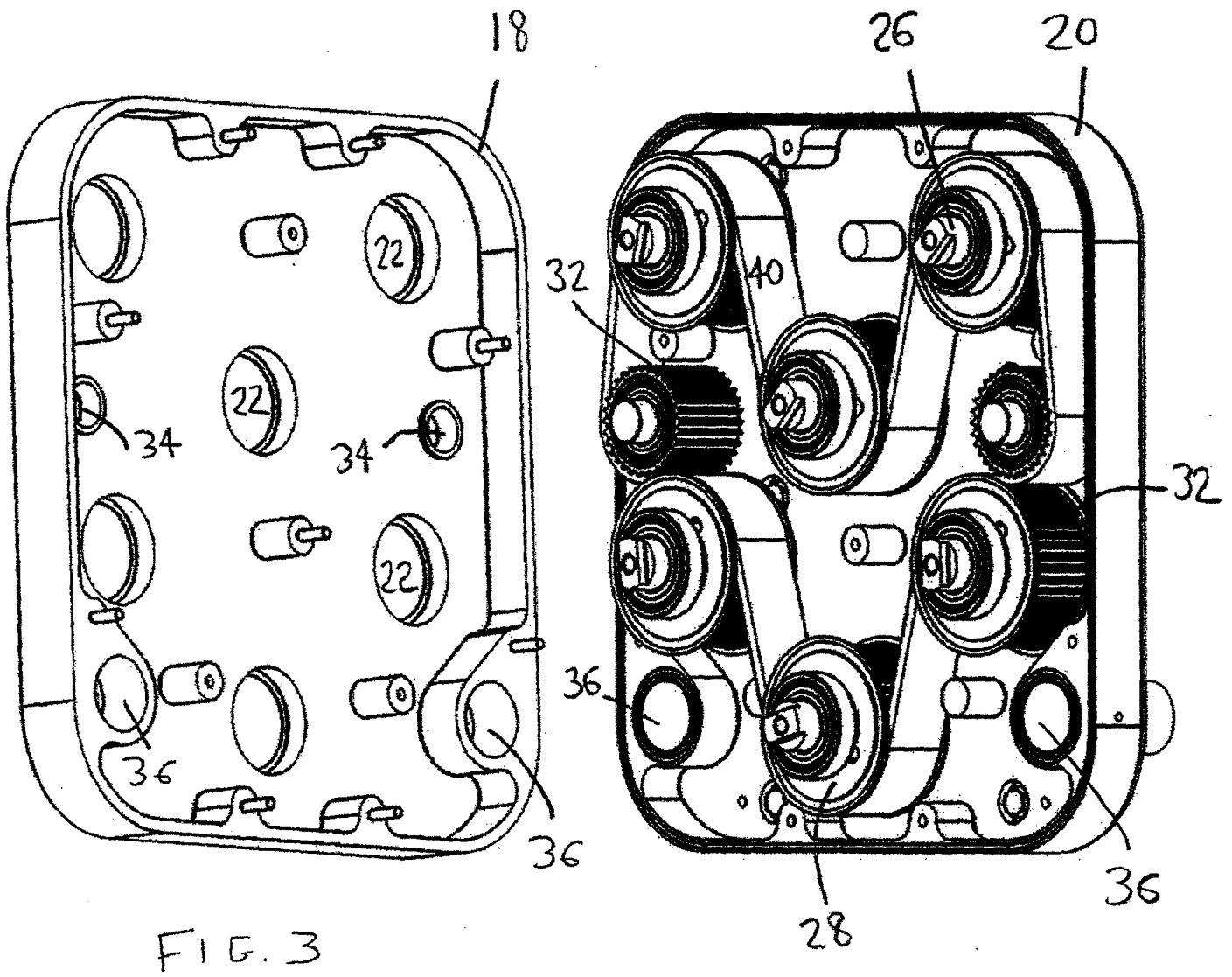


FIG. 2

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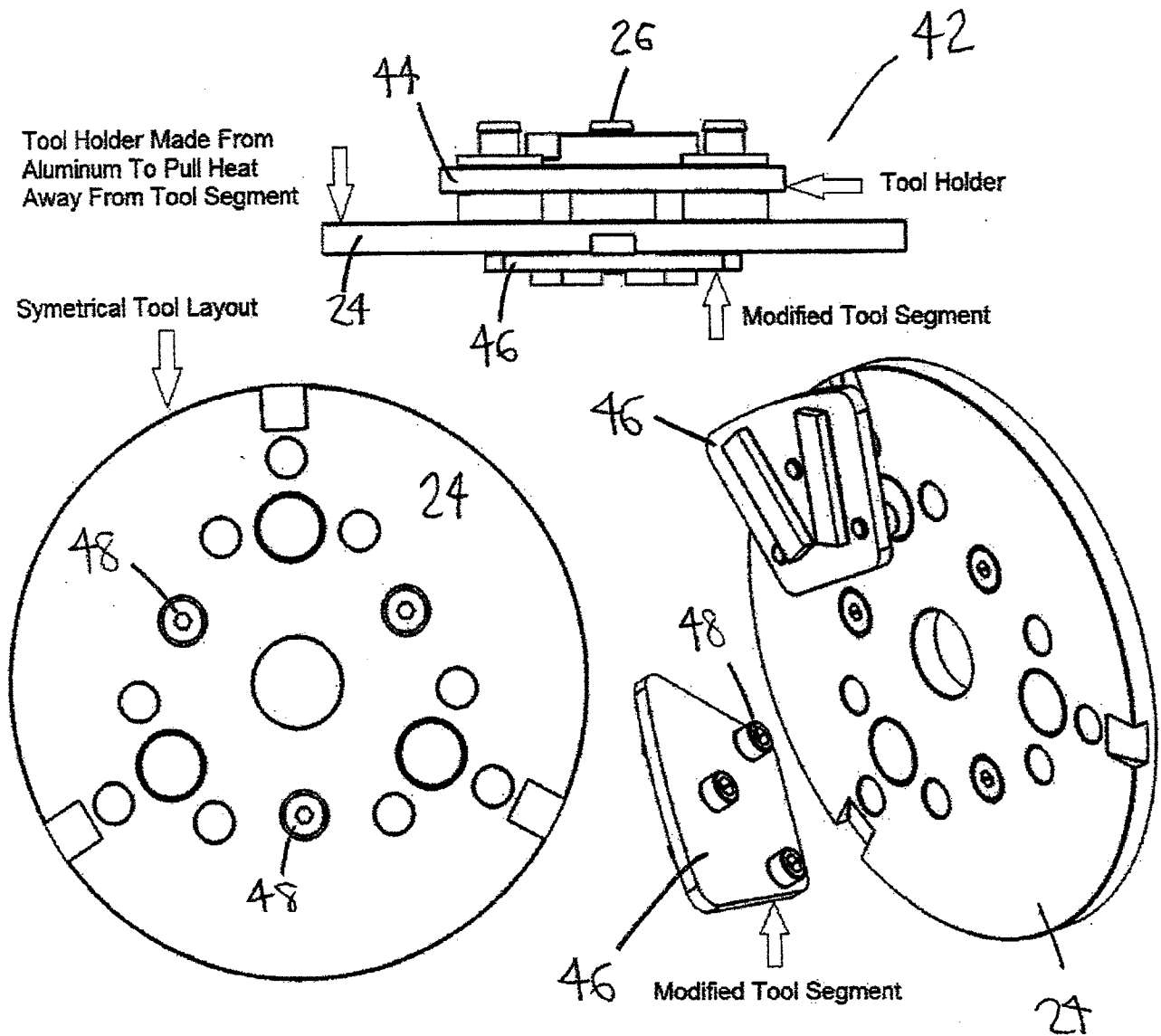


FIG. 4

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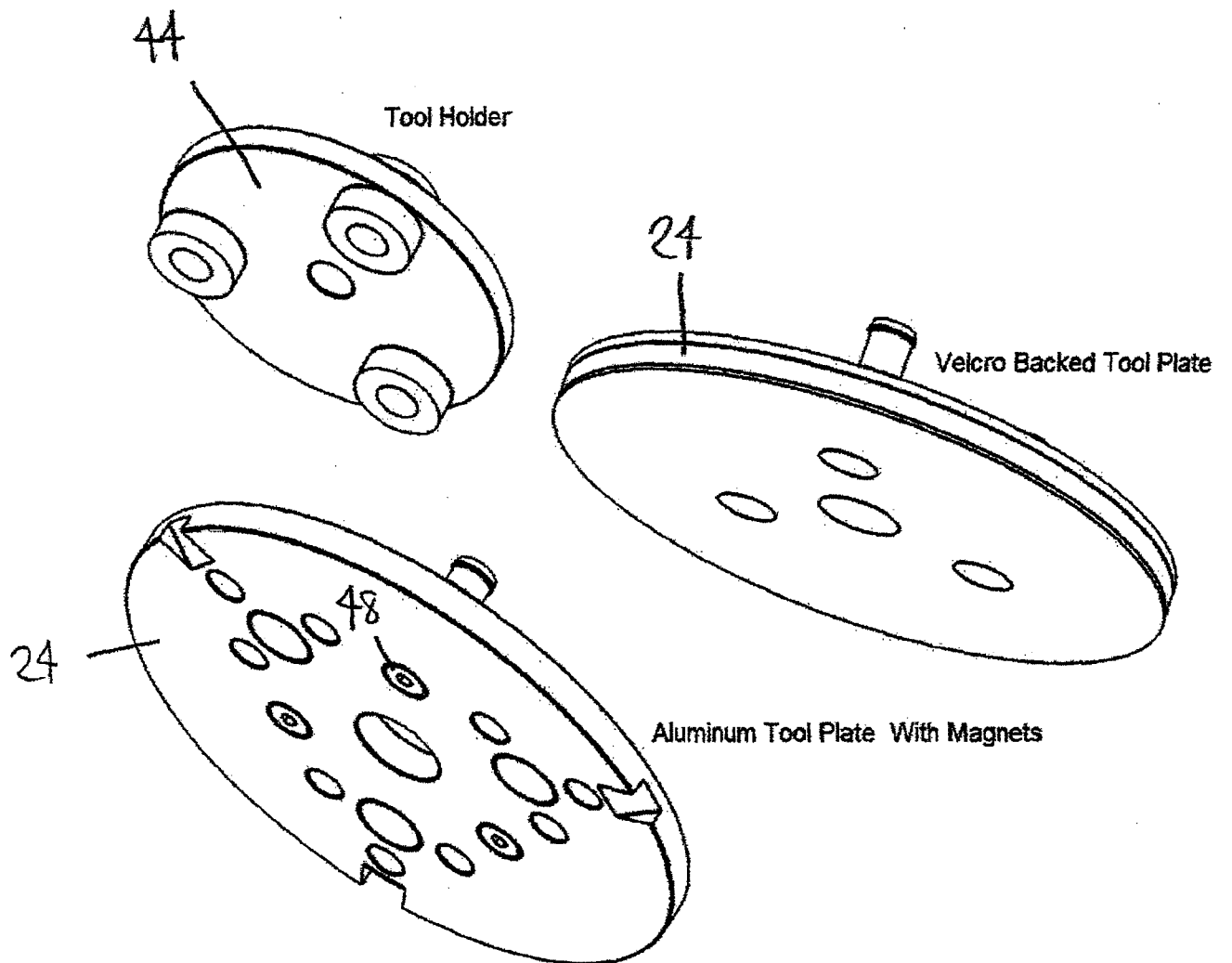


FIG. 5

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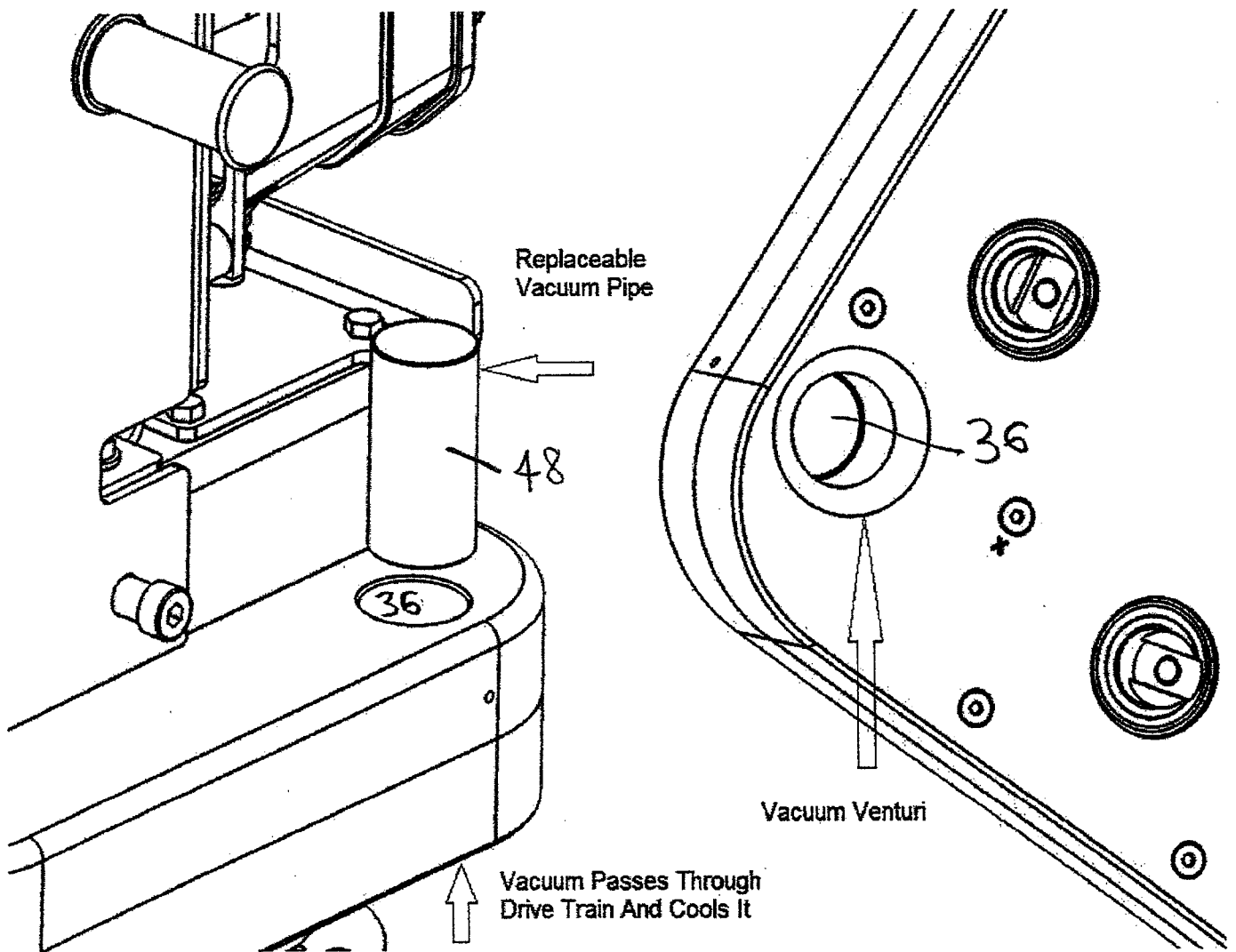


FIG. 6

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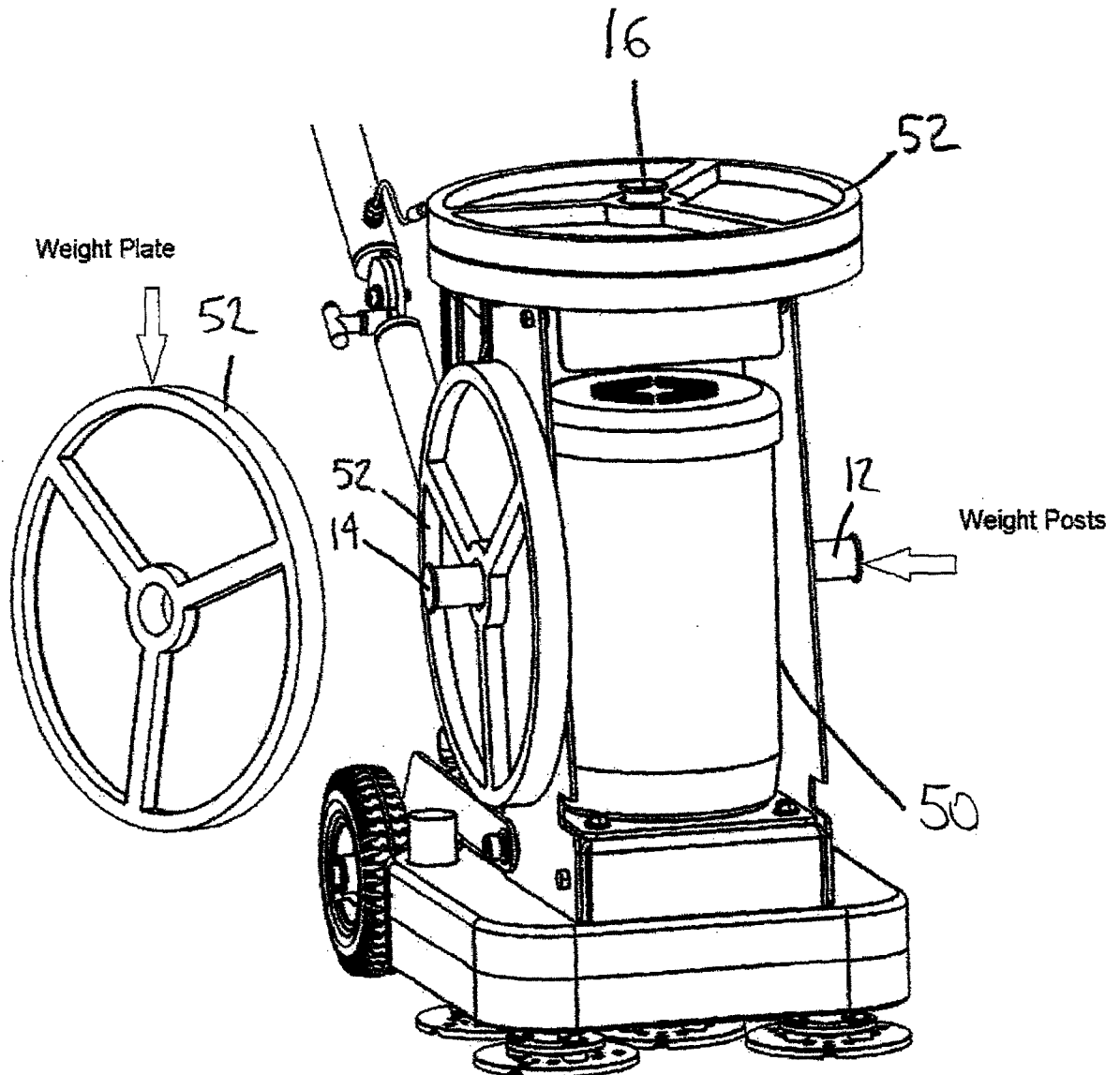


FIG. 7

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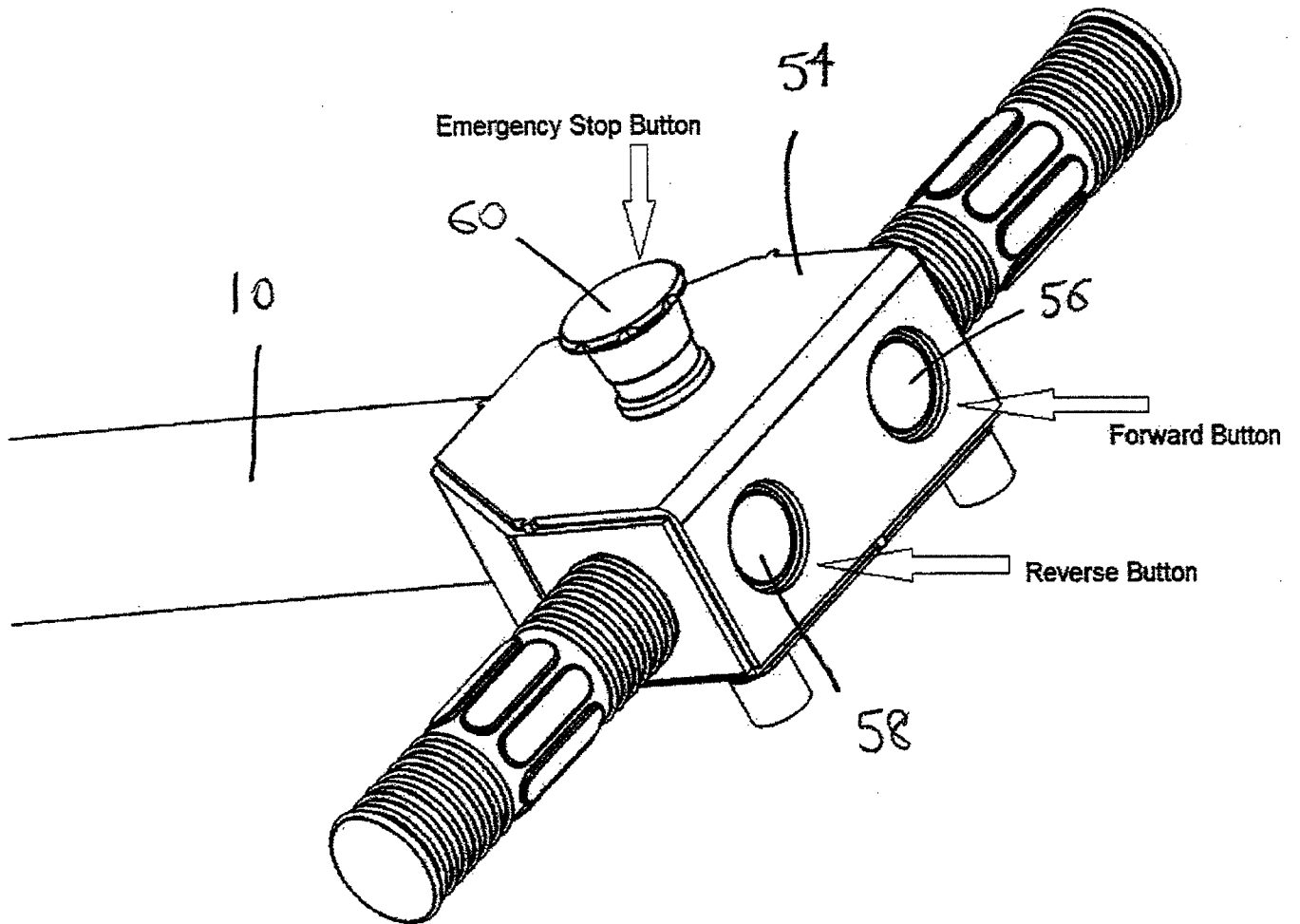


FIG. 8

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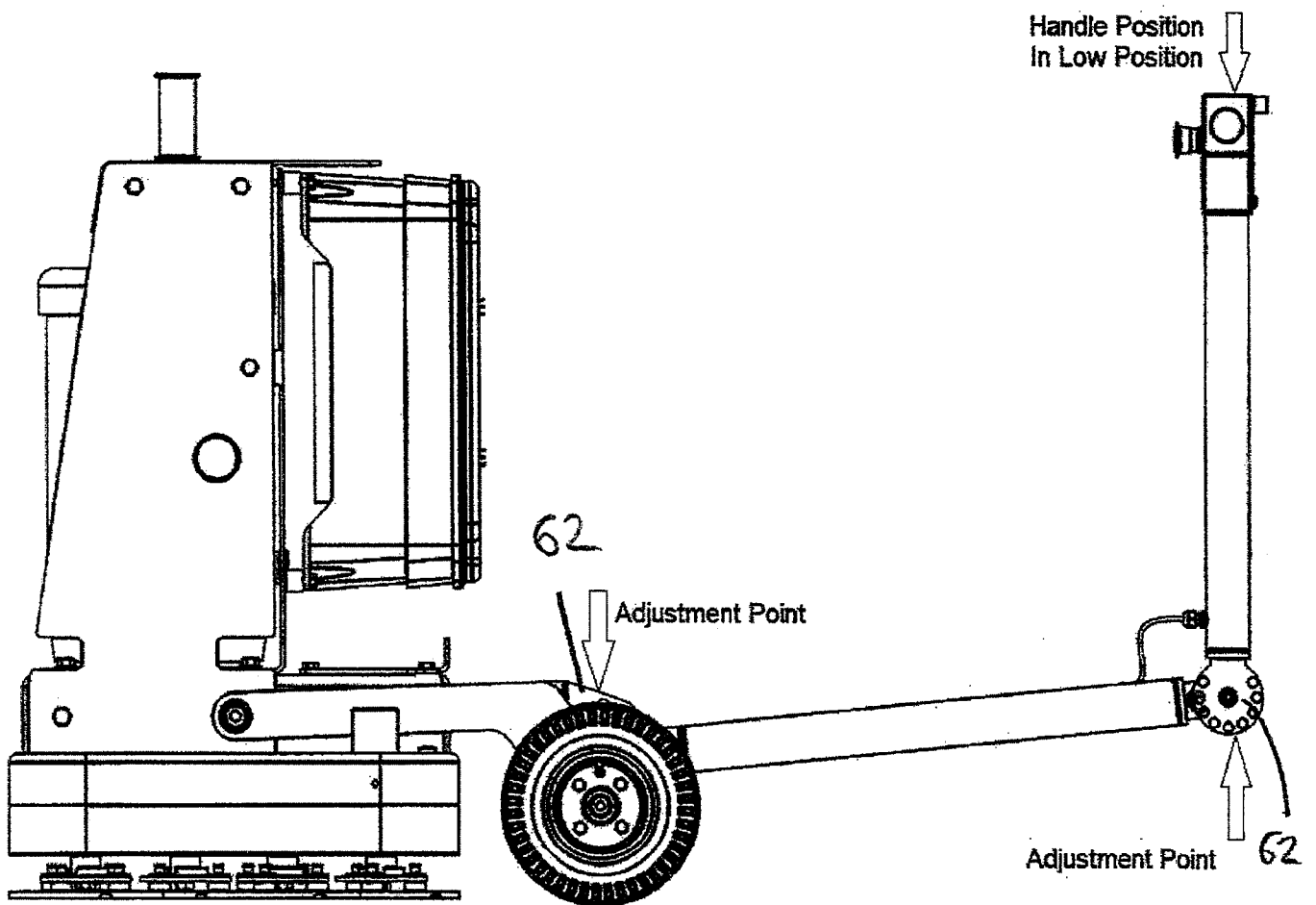


FIG. 9

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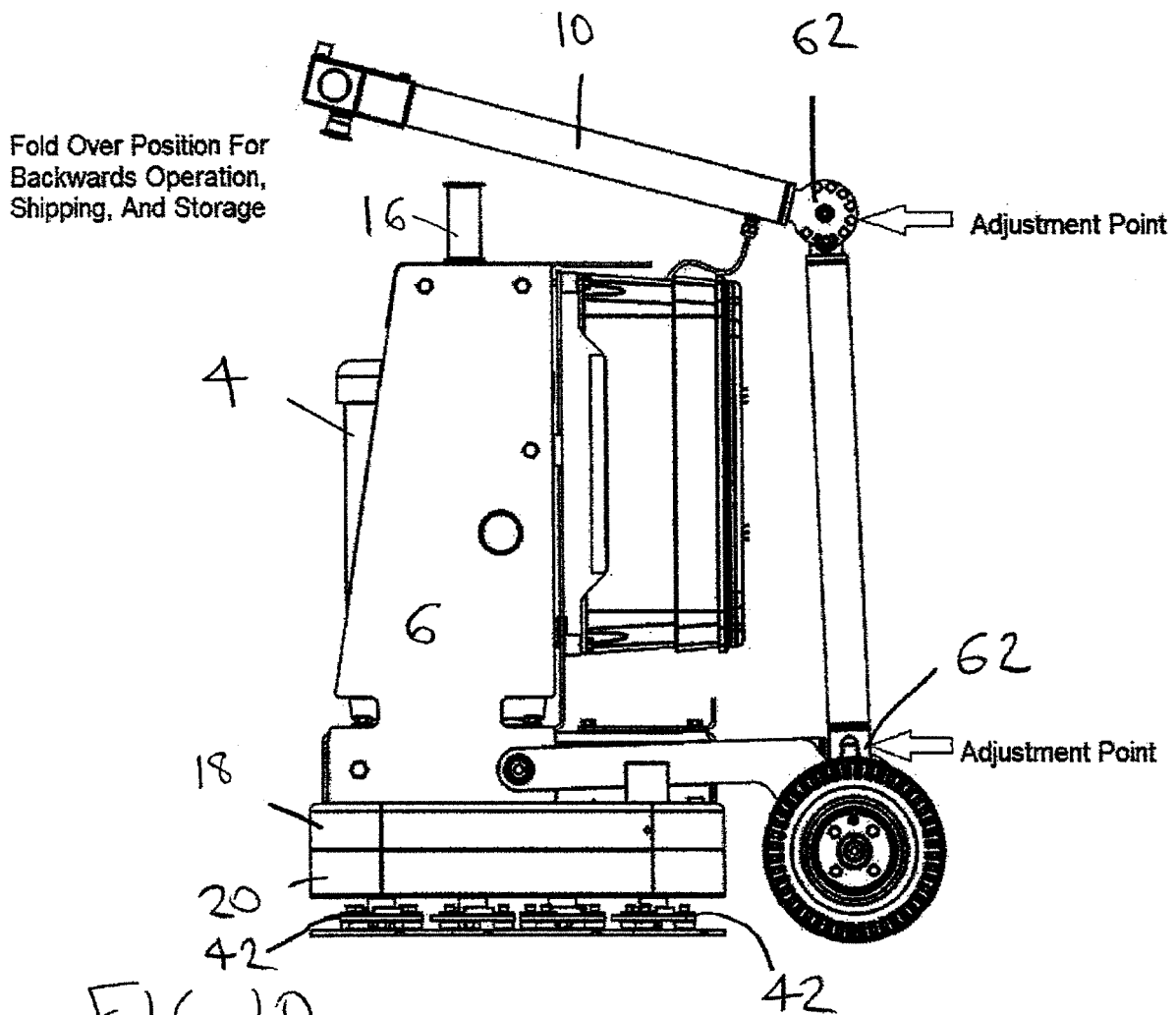


FIG. 10

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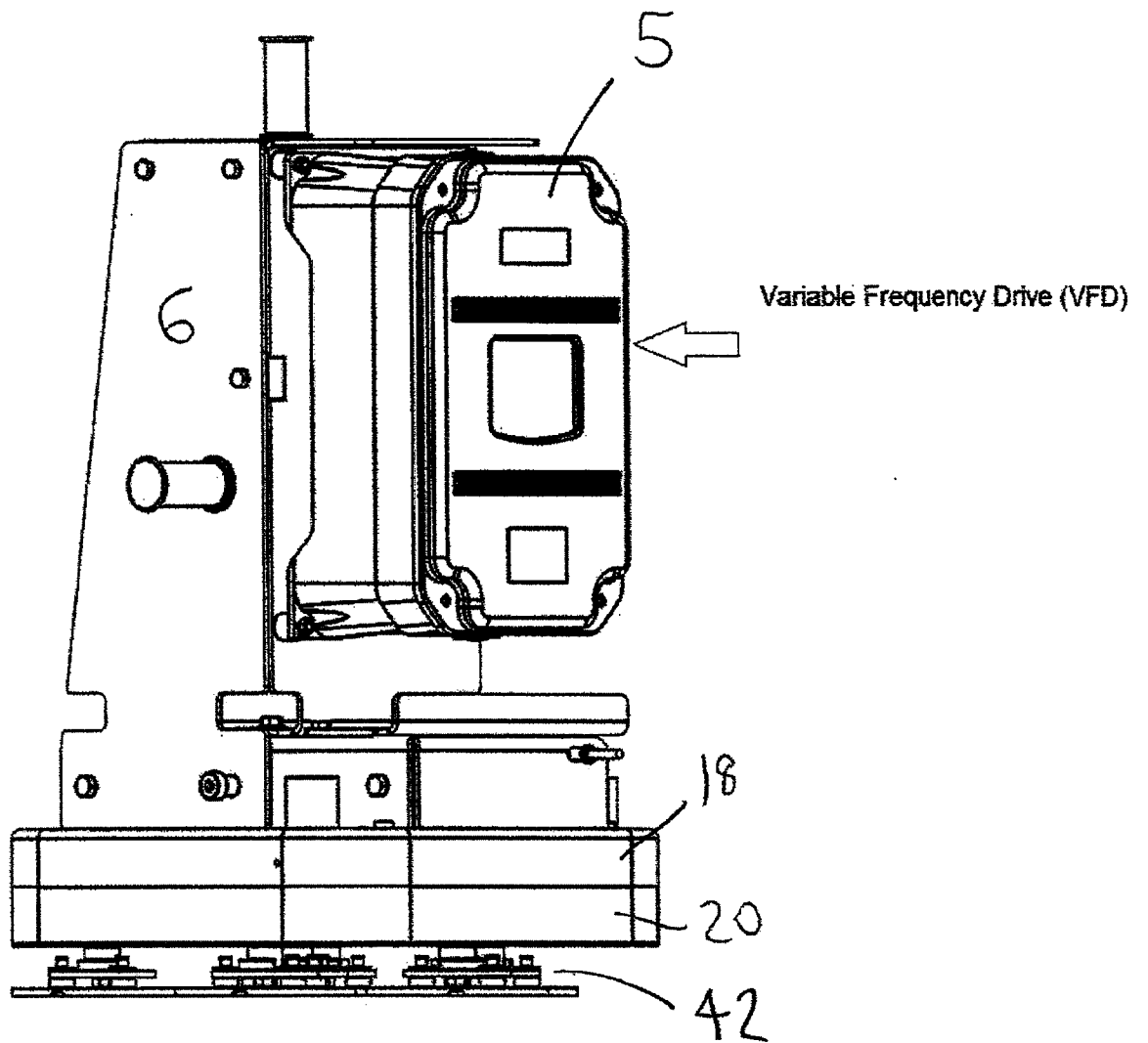


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2013/000049

A. CLASSIFICATION OF SUBJECT MATTER

IPC: **B24B 7/18** (2006.01) , **B24B 23/02** (2006.01) , **B24B 55/10** (2006.01) , **B24B 7/22** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(2006.01): B24B 7/18, B24B 23/02, B24B 55/10, B24B 7/22, A47L 11/02, A47L 11/282

USPC: 451/353, 451/353

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)

EPOQUE (Epodoc and English Full-Text Databases), Canadian Patents Database, WEST (US Patents Full-Text Database); Keywords: abrasive, grind, polish, rotate, vacuum, weight, belt, pulley, floor, disk, disc, magnet, aluminum

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 7,458,883 B2 (WILSON, B. et al.) 02 December 2008 (02-12-2008) * Col. 3, lines 13-19, 56-61 & 66-77; Col. 4, lines 1-4, 8-10 & 32-35; Col. 5, lines 1-3; Col. 6, lines 26-32; Figs. 1-5 & 7 *	1-18
Y	US 7,261,623 B1 (PALUSHI, S.) 28 August 2007 (28-08-2007) * Col. 12, lines 34-37; Figs. 7-9, 14 & 16 *	1-18
Y	US 7,357,700 B2 (LUNDBERG, T. et al.) 15 April 2008 (15-04-2008) * Col. 5, lines 26-31; abstract; Fig. 1 *	1-18
Y	US 2011/0300784 A1 (TCHAKAROV, T. et al.) 08 December 2011 (08-12-2011) * Par. [0022]; Figs. 1 & 3 *	15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

01 March 2013 (01-03-2013)

Date of mailing of the international search report

14 March 2013 (14-03-2013)

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2013/000049

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US7458883B2	02 December 2008 (02-12-2008)	AT439942T AU2006202204A1 DE602007001987D1 DK1813383T3 EP1813383A1 EP1813383B1 US2007178999A1	15 September 2009 (15-09-2009) 16 August 2007 (16-08-2007) 01 October 2009 (01-10-2009) 14 December 2009 (14-12-2009) 01 August 2007 (01-08-2007) 19 August 2009 (19-08-2009) 02 August 2007 (02-08-2007)
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US7357700B2	15 April 2008 (15-04-2008)	US2007264917A1 WO2006036143A1	15 November 2007 (15-11-2007) 06 April 2006 (06-04-2006)
US2011300784A1	08 December 2011 (08-12-2011)	None	