United States Patent [19]

Hutchins

[11] **3,793,781**

[45] **Feb. 26, 1974**

[54] **RECIPROCATING ABRADING OR POLISHING TOOL**

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[22] Filed: **Mar. 10, 1972**

[21] Appl. No.: **233,554**

[52] **U.S. Cl.** ..... **51/170 TL**

[51] **Int. Cl.** **B24b 23/00**

[58] **Field of Search**.....51/170 TL, 170 T, 170 R, 51/170 MT, 356, 270

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[57] **ABSTRACT**

A portable powered sander or the like having a hand held body carrying a rotary motor which reciprocates a working shoe structure relative to the body through a crank element and connecting rod, and which oppositely reciprocates a counterweight relative to the body through a second rotary crank element and connecting rod.

11 Claims, 12 Drawing Figures

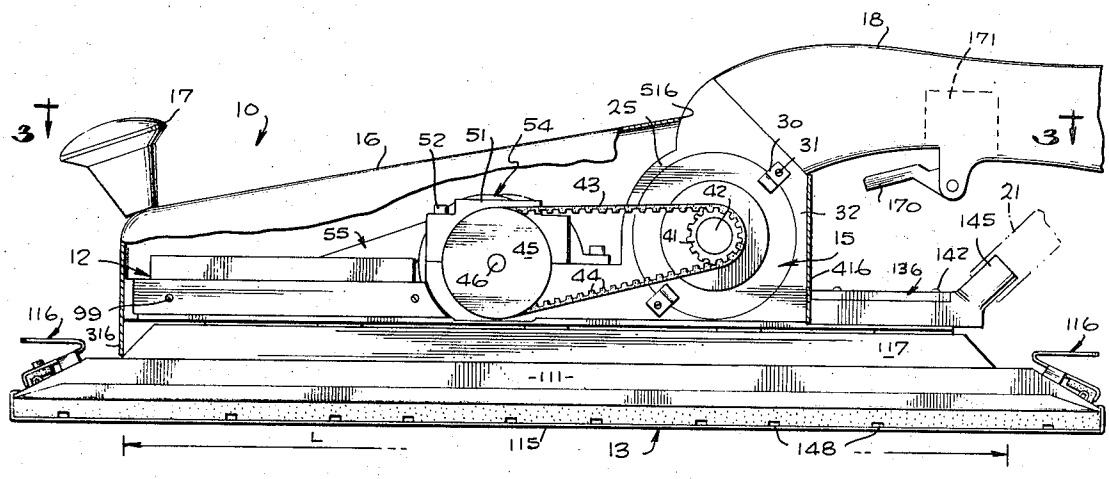
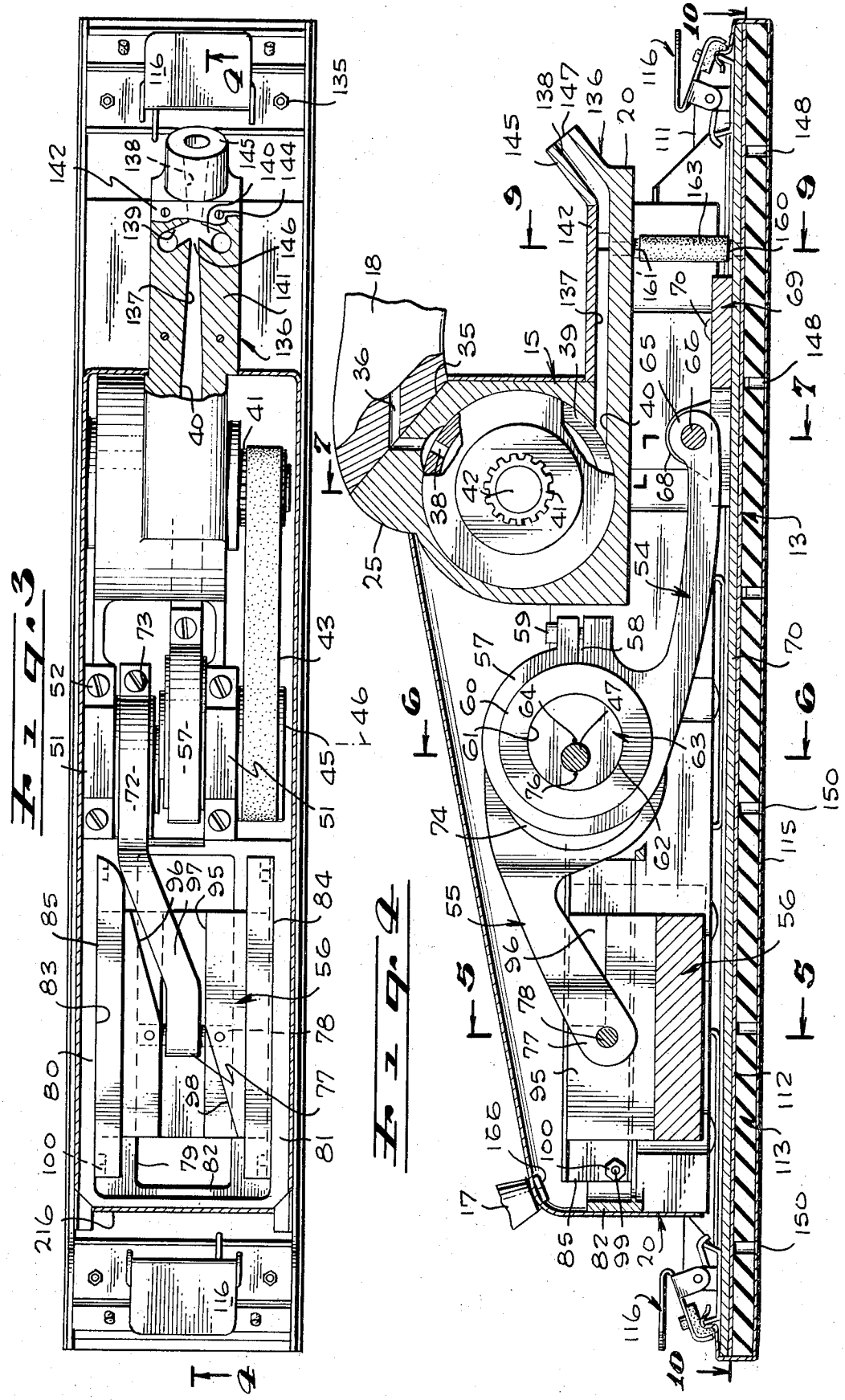


Fig. 9
101
143
141
161'
117
13
113
142
139
70
156
158a
140
162
163
164
157a
154
16
161'
117
101
111
112
160
115

Fig. 1
167
20
19
21
15
11
13
18
516
164
10
165
12
16
17
216
116
14

Fig. 2
3
171
21
145
142
116
170
136
18
117
32
15
416
148
30
31
42
41
516
25
43
44
13
54
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-111-
115
16
55
L
10
17
12
99
316
116
3


FIG. 3
FIG. 2

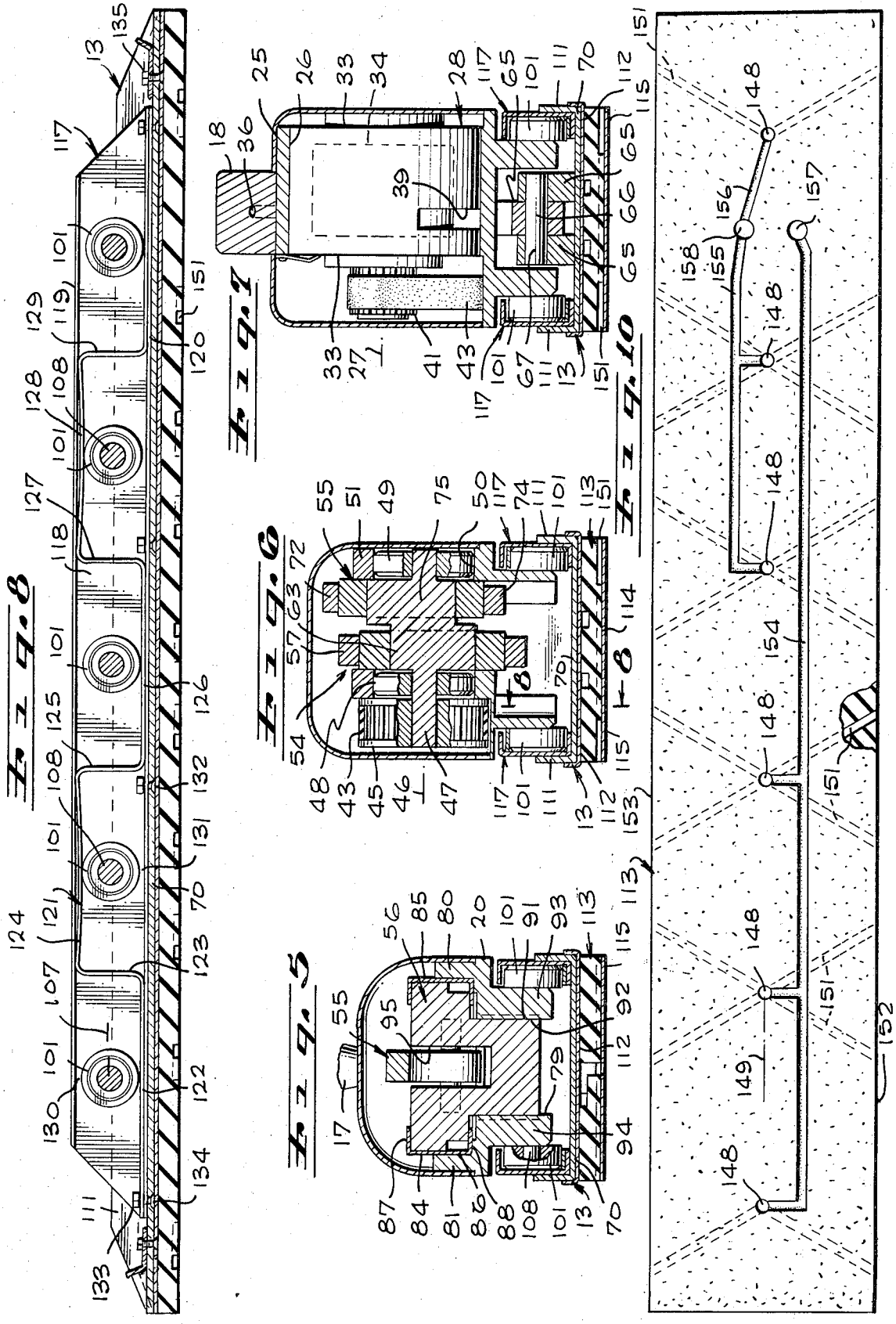
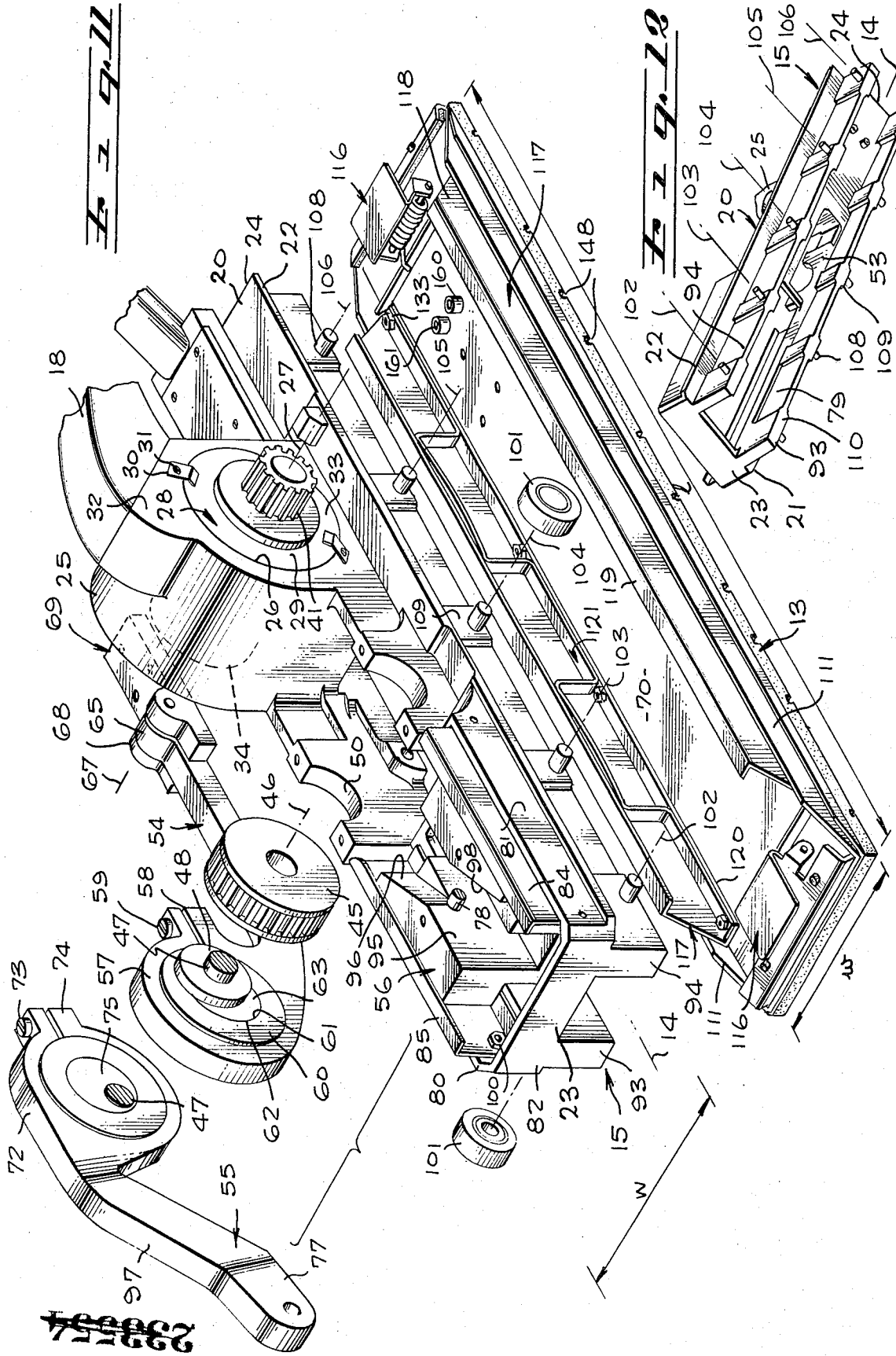

FIG. 8
FIG. 4
FIG. 10
FIG. 6
FIG. 7
FIG. 5

Fig. 11

Fig. 12



RECIPROCATING ABRADING OR POLISHING TOOL

CROSS REFERENCE TO RELATED APPLICATION

Certain features of the structure disclosed in the present application have been shown and claimed in my copending application Ser. No. 213,018 filed Dec. 28, 1971 on "Abrading Tool Having Suction System for Collecting Abraded Particles."

BACKGROUND OF THE INVENTION

This invention relates to portable power operated sanders and other similar tools for either abrading or polishing a work surface, and concerns particularly tools of the 'in-line' type in which a shoe structure carrying the sandpaper or other abrading or polishing element is reciprocated in a straight line relative to a carrying body structure to attain the desired surface treating purpose.

Conventional sanders of the 'in-line' type as currently on the market have had a number of highly undesirable operational characteristics, including for example in most instances an inherent unreliability in operation, as well as an unpredictability of the working stroke of the tool under different operating conditions, excessive noise output, excessive vibration of the tool body in the operator's hands, and various other functional disadvantages. Most of these prior devices are of a type in which a pneumatically driven piston and cylinder mechanism reciprocates the work engaging shoe structure relative to a hand held body in accordance with the powered reciprocation of the piston of the mechanism relative to its associated cylinder. One disadvantage of such piston and cylinder operated sanders has been the tendency for the length of stroke of the piston and the driven working shoe to vary in accordance with the amount of force with which the tool is pressed against the work surface, and/or in accordance with changes in the characteristics of the abrasive material or the engaged work surface, or in accordance with other completely unpredictable and uncontrollable factors, with the result that the sanding effect on the work surface is itself unpredictable and variable. Further, these pneumatic piston and cylinder units have in many instances been inefficient in their use of compressed air, and have developed leaks and other operational problems relatively rapidly when in use. Additionally, many of these tools have been very poorly counterbalanced, and as a result have vibrated the hands of the operator in a very disagreeable manner.

SUMMARY OF THE INVENTION

To overcome these and other disadvantages of prior tools, the present invention provides an improved in-line arrangement in which the reciprocating work contacting shoe structure of the tool is driven by a rotary motor mounted to the body of the tool, with that motor also driving a reciprocating counterweight moving in a straight line relative to the tool body but in opposition to the work engaging shoe. The transmission of power to the shoe is effected by a rotary crank element which drives the shoe through a connecting rod. Similarly, another rotary crank element driven by the motor actuates the counterweight through a second connecting rod, with the counterweight and shoe structure being appropriately balanced to minimize or eliminate any

tendency for vibratory movement of the hand held body of the device.

One particular feature of the invention relates to a unique type of guide structure for mounting a reciprocating working shoe for straight line reciprocal movement relative to a mounting body in a sanding tool or the like. Specifically, this guide structure may include one or more track elements (preferably two parallel tracks), having interfitting rollers received and guided in the tracks, and having liner means of a unique type in the tracks. These liner means are constructed to contact at least one of the rollers at its underside, and at least one other roller at its upper side, and preferably with the engagement at one of these locations being of a resilient character to take up play or looseness in the guide mechanism. For maximum simplicity, the liner means associated with a particular track may be formed as a single elongated strip of hard metal or other material, shaped to have a zigzag configuration extending first along the underside of one of the rollers, then upwardly and past the upper side of the next roller, then downwardly and past the underside of the next roller, etc., or to engage the rollers in any other similar zigzag pattern. The mentioned resilient force may be applied to the rollers by giving some of the roller engaging portions of the strip a resilient characteristic and by preferably bowing those portions to a leaf spring configuration, to take up play in the guide structure as discussed.

Other features of the invention relate to certain improvements in the invention disclosed in my above identified copending application Ser. No. 213,018 and pertaining to the provision of means for removing from the work surface particles abraded therefrom by the tool when in operation. Such removal is effected in my above identified application by a suction system, preferably energized by exhaust air from the motor of the tool through an aspirator arrangement. The present invention contemplates certain improvements in the aspirator, according to which two separate air suction passages are provided to the aspirator from the working shoe. Further, the present invention teaches the provision of grooves formed in the underside of the working shoe for leading air from the peripheral edge of the shoe to a suction passage or passages in the shoe for drawing abraded particles from that peripheral location.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and objects of the invention will be better understood from the following detailed description of the typical embodiment illustrated in the accompanying drawings, in which:

FIG. 1 is a perspective view showing an in-line sander constructed in accordance with the invention;

FIG. 2 is a side view of the FIG. 1 tool, with the housing broken away to reveal the interior of the device;

FIG. 3 is a plan view taken primarily on line 3—3 of FIG. 2, but with the housing and handles and certain other portions of the apparatus broken away;

FIG. 4 is a vertical approximately central section taken on line 4—4 of FIG. 3;

FIGS. 5, 6, and 7 are transverse vertical sections taken on lines 5—5, 6—6, and 7—7 respectively of FIG. 4, with the crankshaft in FIG. 6 being shown as it appears when rotated through 90° from the FIG. 4 position;

FIG. 8 is a fragmentary vertical section taken on line 8—8 of FIG. 6;

FIG. 9 is a transverse vertical section taken on line 9—9 of FIG. 4;

FIG. 10 is a horizontal view taken primarily on line 10—10 of FIG. 4;

FIG. 11 is an exploded perspective view of the tool; and

FIG. 12 is a perspective view of the bottom of the body assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1, a preferred form of sander embodying the invention is illustrated at 10, as it appears while sanding a work surface 11. The tool includes a main hand held body assembly or structure 12, to the underside of which there is movably mounted a sanding shoe assembly 13, which is power reciprocated relative to body 12 in a straight line, and specifically along the front to rear axis represented at 14. The body assembly 12 may in turn include a main body part 15, an upwardly projecting housing 16, and other related parts secured to member 15. The body 12 is hand held and manipulated over the work surface by two front and rear handles 17 and 18, the latter of which contains a passage through which compressed air from a supply hose 19 is delivered to the motor of the tool. An interior suction system withdraws particles which may be abraded from the work surface for discharge into a collecting bag 20 connected by a hose 21 to the remainder of the tool.

As best seen in FIG. 11, the main body part 15 is elongated in the direction of front to rear axis 14 of the tool, and may be considered as of a generally rectangular horizontal outline, having a width W only slightly less than the width w of the horizontally rectangular shoe assembly 13, and having a length L somewhat less than the length l of shoe assembly 13. Body part 15 may be formed as a casting appropriately shaped to mount the various coacting parts to be discussed hereinbelow. To describe the shape of this casting in detail, part 15 may for purposes of discussion be considered as having a main horizontal externally rectangular plate-like portion 20, having parallel straight line front to rear side edges 21 and 22 spaced apart the previously mentioned width distance W, and having two parallel transverse front and rear edges 23 and 24 extending perpendicular to axis 14. This horizontal plate-like portion 20 of body part 15 carries at a location near rear edge 24 an upwardly projecting portion 25 of part 15, containing a cylindrical passage or opening 26 centered about an axis 27 which extends transversely with respect to the front to rear axis 14 of the tool. Within this opening 26, there is mounted a conventional rotary motor 28, preferably of the pneumatic type including an externally cylindrical housing 29 which is a close fit within opening 26 and is secured therein by retainers 30 held by screws 31 attached to the parallel planar vertical side surfaces 32 of portion 25 of body 15. These side surfaces 32 and the opposite end walls 33 of motor housing 29 may lie in vertical planes which are parallel to front to rear axis 14. Within housing 29, motor 28 contains a rotor diagrammatically represented at 34 in FIG. 11, which may carry or include a series of vanes against which compressed air from supply line 19 exerts pressure, to turn the rotor about axis 27. As seen best in FIG. 4, the rearwardly projecting rear handle 18 of the tool is connected at its forward end to an upper inclined surface 35 formed on portion 25 of part 15, so that the air supply passage 36 in handle 18 can communicate through a passage 37 with an air inlet opening 38 formed in motor housing 29 to lead the compressed air to the rotor. The air discharges from the motor through a slot or opening 39 formed in the rear underside of motor housing 29, to communicate with a passage 40 forming a portion of the suction system for withdrawing abraded particles from the work, as will be discussed in greater detail at a later point. The rotor 34 or the motor drives a toothed sprocket wheel or gear 41 located at the left side of the motor, through connection of the sprocket wheel to the rotor shaft 42 which turns about axis 27. This sprocket wheel 41 in turn drives an endless flexible belt 43 (FIG. 2) which desirably has internal cogs or teeth 44 engaging the teeth on sprocket wheel 41, and also engaging peripheral teeth on a second toothed sprocket wheel 45, which turns about an axis 46 parallel to and spaced forwardly of axis 27. Wheel 45 may have an effective diameter somewhat larger than (preferably approximately twice as great as) that of sprocket wheel 41, to introduce a speed reducing effect into the drive.

As seen best in FIG. 6, wheel 45 is mounted rigidly to a crankshaft 47, which is driven rotatively about the transverse axis 46 by wheel 45. To mount the crankshaft for its rotation, there may be provided two laterally spaced bearings 48 and 49 suitably secured in fixed position relative to body part 15, as by shaping part 15 to form two upwardly facing semicircular bearing receiving recesses 50 at a location forwardly of motor 28, with semicircular bearing retaining straps 51 being secured thereto by screws 52 to enclose the upper halves of the bearings. Laterally between the two bearings 48 and 49, part 15 may contain an opening 53 extending downwardly through the entire thickness of part 15, to allow for connection to the crankshaft of the driven ends of two connecting rods 54 and 55 for driving the shoe assembly 13 and a counterweight 56 respectively. As seen best in FIGS. 3, 4, and 6, connecting rod 54 has a forward strap-like circular portion 57 which is circularly discontinuous at 58 and is tightenable at that location by a clamping screw 59 to constrict the annular strap portion 57 radially inwardly against the outer cylindrical surface of an annular bearing element 60. The radially inner bearing surface 61 of part 60 in turn engages the outer bearing surface 62 of an eccentric crank element 63 which is rigidly carried by or formed integrally with crankshaft 47, to turn therewith about axis 46. As will be apparent from FIG. 4, the outer bearing surface 62 of crank element 63 and the inner bearing surface 61 of the engaged element are centered about an axis 64 which is offset eccentrically from and parallel to the main axis 46 of the crankshaft, so that rotation of the crank element 63 with the crankshaft causes a revolving movement of portion 57 of connecting rod 54 about the crankshaft axis, and in turn causes a front to rear reciprocating movement of the second end 65 of the connecting rod parallel to front to rear axis 14 of the tool. The connecting rod extends rearwardly and generally horizontally from the location of its forward crankshaft engaging end to its rear end 65, which is then connected pivotally to shoe assembly 13 by means of a horizontal transverse pin 66 centered about an axis 67 parallel to axes 27 and 46. This pin is connected at its opposite ends into two upstanding

mounting lugs 68 formed on a bracket 69 which is secured rigidly by screws 70 to the upper side of a main horizontal plate 70 of the shoe assembly, to thereby reciprocate the shoe assembly in a front to rear direction in response to rotation of the motor. As seen best in FIG. 4, the connecting rod 54 in extending rearwardly passes beneath the underside of the previously discussed main horizontal plate portion 20 of body part 15, and in particular beneath the location of the motor which is carried at the upper side of that plate portion.

The second connecting rod 55 is secured to the crankshaft 47 in essentially the same manner as has been discussed in connection with connecting rod 54, and in particular by an essentially annular but circularly discontinuous clamping strap portion 72 of connecting rod 55 (see FIGS. 3 and 6), which is secured by a screw 73 to a bearing ring 74, which in turn rotatably engages a crank element 74 (FIG. 6) rigidly secured to or formed integrally with crankshaft 47. The second crank element 75 may be identical with the first discussed crank element 63, but be offset 180° with respect thereto, so that the axis of the second crank element is at 76 in FIG. 4, and is parallel to axis 46 and offset therefrom the same distance as the first eccentric axis 64, but in the opposite direction. Thus, when connecting rod 54 is moving rearwardly, connecting rod 55 moves forwardly, and vice versa. The connecting rod 55 projects forwardly from the location of the driving crankshaft to an end 77 which is pivotally connected to a transverse pin 78 parallel to the previously mentioned pin 66 and the various axes 27, 46, etc. This pin in turn is connected at its opposite ends to counterweight 56, to form a pivotal connection between the connecting rod 55 and the counterweight in a relation causing front to rear reciprocating movement of the counterweight in response to rotation of the crankshaft and motor. The various bearings which support shaft 47, and those which attach the shaft to the connecting rods, may of course be of any conventional type, such as ball bearings, roller bearings, sleeve bearings, etc.

To provide for reception and mounting of counterweight 56 in main body part 15, the main horizontal portion 20 of part 15 is shaped to contain an essentially rectangular opening 79 extending vertically therethrough. Above the level of the previously discussed horizontal plate portion 20 of part 15, the latter may form two upwardly projecting parallel side flanges 80 and 81 (FIGS. 3 and 5), interconnected at the forward end of part 15 by an upstanding transverse flange 82 (FIGS. 3 and 4), with these flanges 80, 81, and 82 defining an essentially rectangular recess 83 somewhat wider than the opening 79 in plate portion 20 of part 15 (FIG. 3), to receive and retain two counterweight mounting opposite side tracks 84 and 85. These tracks have the vertical cross-sectional configuration illustrated in FIG. 5, each having a vertical web portion 86 received against and located by the vertical surface of the corresponding upstanding flange 80 or 81 of part 15, and lying in a vertical plane parallel to the front to rear axis 14 of the tool. Each of the tracks also has two parallel top and bottom horizontal flanges 87 and 88, so that the tracks define two opposed channel shaped guideways within which the oppositely laterally projecting upper side portions 89 and 90 of the counterweight are slidably received and guided to confine the counterweight for only straight line reciprocal movement parallel to axis 14. A reduced width portion 91 of the counterweight projects downwardly beneath the level of the tracks and into opening 79, and is slidably guided and confined by sliding engagement with two vertical surfaces 92 formed at the inner sides of a pair of depending front to rear flanges 93 and 94 which project downwardly from and are integral with plate portion 20 of part 15. For reception of the forward end 77 of connecting rod 55, the counterweight may have an upper recess 95 formed therein and extending in a front to rear direction, with pin 78 extending into the counterweight at the opposite sides of this recess. The upper portion of the counterweight may be cut away angularly at one side of this recess, as indicated at 96 in FIG. 3, to allow for reception of an angularly extending portion 97 of the connecting rod 55. For symmetry and balance, a similar portion may be cut away angularly at 98, at the other side of the recess 95, and in a manner allowing connection of the counterweight into the track structure with either of its ends forward. The tracks 84 and 85 may be secured rigidly to part 85 in any suitable manner, as by screws 99 extending through lower edge portions of housing 16 and through flanges 80 and 81 and the tracks and connecting to nuts 100 at the inner sides of the front and rear ends of the tracks (these nuts being sufficiently far forward or rearward to avoid interference with the front to rear reciprocal movement of the counterweight).

As seen best in FIG. 12, the two depending flange portions 93 and 94 of main body part 15 extend parallel to one another and parallel to main axis 14 of the tool, at opposite sides of the counterweight and the rearwardly projecting connecting rod 54. These flange portions rotatably mount two series of externally cylindrical guide rollers 101, for guiding the shoe assembly 13 for its reciprocal movement relative to the body of the device. Desirably, there are five such rollers at the outer side of each of the flange portions 93 and 94, mounted rotatably about five spaced horizontal axes 102, 103, 104, 105, and 106, all of which may lie in a common horizontal plane 107. For mounting these rollers, each flange 93 or 94 may carry five cylindrical stub shafts or pins 108, which project laterally into the rollers and about which the rollers are rotatably carried. At the location of each of the rollers, the associated flange portion 93 or 94 may have a vertical planar surface 109 adjacent which the roller is received. Internally, the two flanges 93 and 94 may have thickened portions 110 at the locations of the stub shafts 108, to assure effective connection of the stub shafts to the flanges.

To now describe the structure of the reciprocating shoe assembly 13, this assembly includes the previously mentioned horizontal rectangular rigid main plate 70, which may have two upstanding parallel side flanges 111 (FIG. 6) lying in planes parallel to main axis 14. At the underside of plate 70, the shoe assembly includes a second typically thinner metal plate 112 to the underside of which there is cemented or otherwise secured a thicker sheet or layer of resilient cushioning material 113, formed of an appropriate flexible plastic or rubber cushioning substance and having an essentially planar or flat undersurface 114 along the underside of which a sheet of sandpaper 115 extends for contacting the work surface 11. The opposite ends of the sandpaper sheet extend upwardly at the opposite ends of the shoe assembly, for releasable retention by two spring clips

116 mounted to the upper side of the end portions of plate 70.

Projecting upwardly from plate 70 along its opposite side edges there are provided two elongated parallel tracks 117, which extend parallel to axis 14 and coact with rollers 101 to guide the shoe assembly for only straight line reciprocal movement. These tracks have the vertical cross-sectional configuration illustrated in FIGS. 5, 6, 7, and 9, each having a vertical planar web portion 118 received adjacent one of the upstanding side flanges 111 of bottom plate 70, and each also having two horizontal parallel inwardly projecting top and bottom flanges 119 and 120 received at the top and bottom sides of the coacting rollers.

Each of the tracks 118 desirably contains a liner element 121 (FIG. 8), which is the part directly contacted by the various rollers in a manner taking any wear which may occur and enabling easy replacement of the roller engaging surfaces. This liner may be formed of an elongated strip of relatively hard wear-resisting material, such as a suitable resilient spring steel, and may have the zigzag configuration illustrated in FIG. 8 to engage only the undersides of some of the rollers and only the upper sides of others of the rollers, desirably alternately. For example, as seen in FIG. 8, the liner extends horizontally at 122 along the underside of the leftmost roller 101 in that figure, and along the upper surface of the bottom flange 120 of the corresponding track, and then after passing that first roller extends directly upwardly at 123, and then generally horizontally at 124 past a position of engagement with the second of the rollers. After passing that roller, the liner strip extends downwardly at 125 and then horizontally at 126 along the upper side of track flange 120 to engage the next roller, following which element 121 extends upwardly at 127 and then generally horizontally at 128 to engage the upper side of the fourth roller, and then downwardly to engage the underside of the fifth roller at 129. Downward forces from the first, third, and fifth rollers through portions 122, 126, and 129 of the liner are transmitted to the track without play, so that when the tool is placed on a work surface there is no downward movement of the body 15 and related parts relative to the track assembly. To maintain this direct abutting engagement of the first, third, and fifth rollers with the liner, and the corresponding direct abutting engagement of the contacted portions of the liner with the track, the other two rollers may be yieldingly urged downwardly by portions 124 and 128 of the track. For this purpose, these portions 124 and 128 are resilient, and may be bowed slightly downwardly as seen in FIG. 8, to continuously yieldingly urge the rollers downwardly relative to the track, and thereby take up any play which might otherwise be present between the body assembly and the shoe assembly. It may be noted that the spacing between the upper and lower flanges 119 and 120 of the side tracks is sufficiently great to assure contact of each of the rollers with liner 121 at only the underside or upper side of the roller, and not at both of those locations. For instance, the leftmost roller in FIG. 8 is spaced from the top flange of the track at 130, and does not engage that track surface. Similarly, the next roller is spaced at 131 from the bottom flange of the track, etc.

The various elements of the shoe assembly are secured together in relatively fixed positions by any appropriate means. These connections may for example include screws 132 (FIG. 8), extending upwardly through plate 70 and through the bottom flange 120 of each track 117 to connect to nuts 133 contained within the tracks at a location avoiding interference with the rollers or liner. At the opposite ends of liner 121, two of these screws may also extend upwardly through openings formed in the opposite ends of liner strip 121, as at 134, to function also to retain the liner in place within the channel shaped track. Additional screws 135 may secure plate 112 and its attached cushion 113 to plate 70 and to the mounting portions of clips 116.

For picking up from the work surface 11 and its vicinity particles sanded from that surface, the tool has a vacuum system energized by an aspirator arrangement represented at 136 in FIGS. 3 and 4. The passages 137, 138, 139 and 140 of this aspirator (FIG. 3) may be formed as grooves in the upper surface of a portion 141 of part 15, which portion 141 projects upwardly a short distance above the previously discussed main horizontal plate-like portion 20 of part 15, with these grooves being closed at their upper sides by a horizontal cover plate 142 extending across the horizontal upper surface 143 of portion 141, and appropriately sealed with respect thereto by suitable gaskets. Cover plate 142 may be secured in position on portion 141 by screws or other fasteners as represented at 144 in FIG. 2. At the rightward extremity of portion 141 in FIG. 2, this portion may form an angularly upwardly turned discharge tube, as represented at 145, so that the discharge hose 21 leading to dust collection bag 120 can avoid interference with the clip 116 which is therebeneath.

Referring again to FIG. 3, the first aspirator passage 137 receives the exhaust air from motor 28 through passage 40, and in effect forms a rightward continuation of that passage. As the 'primary' aspirator passage 137 advances rightwardly in FIGS. 3 and 4, it may progressively taper to a reduced cross section at the location 146, to form at that location a nozzle through which the rapidly moving primary air stream from the motor is emitted rightwardly into a somewhat enlarged diameter entrance portion 147 of the continuation passage 138 which leads into hose 21. Just beyond the nozzle at 146, the two secondary or side passages 139 and 140 (the suction passages of the aspirator) lead into the opposite sides of the primary air flow path, in a manner creating a suction by aspirator action in passages 139 and 140 acting to pull a flow of air contained dust particles from those passages into the main stream leading into the dust collection bag.

To now define the paths by which suction air from the work surface flows to the aspirator suction passages 139 and 140, attention is directed to FIGS. 4 and 10, which show at 148 a series of suction apertures (typically six such apertures), which extend vertically upwardly from the undersurface 114 of pad 113, through the material of that pad and to the underside of the metal plate 112 which is bonded to the upper side of the pad. These apertures or passages 148 may be aligned longitudinally of the tool along the center line 149 of the shoe assembly (parallel to axis 14). A series of corresponding apertures 150 (FIG. 4) are formed in the sheet of sandpaper 115, so that air may be drawn upwardly from the work surface through the apertures in the sandpaper and through passages 148 to the upper surface of pad 113. Also, there may be formed in undersurface 114 of the pad a number of grooves 151

which extend laterally to the opposite side edges **152** and **153** of the pad, to draw air inwardly from opposite sides of the pad to the passages **148.**

From the upper ends of passages **148** in the pad, the suction air and carried dust are withdrawn through passages **154, 155,** and **156** to the locations **157** and **158** of FIG. **10,** at which a pair of registering apertures **157***a* and **158***a* are formed in plate **112** (see FIG. **9**). These passages **154, 155,** and **156** may be formed as grooves in the upper surface of pad **113,** closed at their upper side (except at locations **157** and **158**) by plate **112** which is sealed to the upper surface of the pad along the sides of the various grooves. Preferably, one of the apertures **158***a* communicates with and draws air from three of the passages **148** through passages **155** and **156,** while the other aperture **157***a* communicates through passage **154** with the other three apertures **148.**

After the air reaches the locations of the apertures **157***a* and **158***a*, it flows upwardly through those apertures (FIG. **9**) into two short vertical tubes **160** and **161** mounted in appropriate openings in top plate **70.** From these tubes, the air and dust flow upwardly into the lower ends of two passages **161** formed in part **15** at the locations of and communicating with the outer extremities of the two previously mentioned passages **139** and **140** of FIG. **3.** Two rigid tubes **162** projecting downwardly from and beyond the lower ends of passages **161** may connect into the upper ends of two short flexible hoses **163,** whose lower ends connect to tubes **160,** to conduct air upwardly through the hoses while permitting flexibility of the hoses in a manner avoiding interference with the reciprocal motion of the shoe assembly relative to the body structure.

The housing portion **16** of the body assembly may be a simple sheet metal stamping or the like, forming a hood over most of the working parts of the apparatus, and having a lower peripheral edge **164** which is appropriately secured to the opposite side edges of body **15,** as by screws or other fasteners **165.** The front wall **216** of the housing engages the front of part **15** at **316** (FIG. **2**), while the rear wall **416** engages the back side of motor containing projection **25,** with a suitable opening being formed in the housing at **516** through which handle **18** may be connected to the body **15.** The forward handle **17** of the tool may be suitably secured to the front end of the housing, as by a nut **166** connected to a threaded pin or screw projecting from the knob handle to the interior of the housing.

To now describe the manner of use of the illustrated tool, assume that hose **14** is appropriately connected to a source **167** of compressed air, and that the sandpaper sheet **115** has been connected onto the shoe assembly in the position illustrated in FIG. **4,** and with apertures **150** in the sandpaper communicating with passages **148** in the shoe assembly. An operator may then place the sandpaper on a work surface, and commence operation of the sander by actuating trigger **170** on handle **18** to open an inner valve **171** in the handle for admitting air to the motor. This then commences powered rotation of the vaned rotor of the motor, to drive sprocket wheel **27,** and through belt **43** to drive crankshaft **47** and the crank elements **63** and **75.** The crank elements cause reciprocating movement of the shoe assembly and counterweight **56** in opposite counterbalancing directions relative to main body part **15.** The mass of the counterweight and all parts reciprocating with it is desirably exactly equal to and exactly counterbalances the weight of the shoe assembly and all parts reciprocating with it, so that the net effect is to eliminate any tendency for vibration of the body **15** itself and the handles by which the operator holds the tool. As dust particles are formed from the material of the work surface by the sanding action, these particles are drawn upwardly through apertures **150** and **148** in the sandpaper and shoe pad, and then through passages **154, 155,** and **156,** and flexible tubes **163** into passages **139** and **140** of the aspirator, through which they are drawn into the main air stream discharging from the motor to collection bag **20.** If at any time one end of the shoe is moved beyond the edge of the work surface, some of the suction passages or apertures **148** in the shoe may become so unrestricted as to reduce the suction effect through those apertures. However, normally at least three of the apertures **148** will remain over the work, including all of the apertures associated with either the passage **139** or the passage **140** of FIG. **3,** so that an essentially undiminshed suction will be maintained through those three apertures. As will be understood, this result is attained by virtue of the fact that the six air passages **148** in the shoe lead into the primary air flow passage **137–138** of the aspirator through the two entirely separate secondary or suction passages **139** and **140.**

The grooves **151** formed in the undersurface of the shoe cushion **113** also form a number of additional branches of the suction passages, leading inwardly from the opposite side edges of the shoe between the suction and sandpaper, to draw air from the sides of the tool as well as through bottom apertures **148.** In this way, the work surface is maintained essentially clean at all times, and the tool prevents the formation of the usual large amounts of dust conventionally found in automobile body shops and the like using sanding tools. As an added advantage, the provision of the dust collection bag in the air discharge line from the motor effectively muffles the sound of the motor exhaust.

While a certain specific embodiment of the present invention has been disclosed as typical, the invention is of course not limited to this particular form, but rather is applicable broadly to all such variations as fall within the scope of the appended claims.

I claim:

1. A portable work abrading or polishing tool comprising a portable body structure; handle means for manipulating said body structure; a shoe structure movable relative to said body structure to abrade or polish a work surface; first guide means guiding the shoe structure for essentially straight line reciprocal movement along a predetermined axis relative to said body structure; a counterweight; second guide means mounting said counterweight movably to said body structure for reciprocal movement relative thereto and essentially parallel to said axis of movement of the shoe structure; a rotary motor mounted to said body structure; two crank elements driven rotatively relative to said body structure by said motor; a first connecting rod driven by a first of said crank elements and connected to said shoe structure to reciprocate the latter in correspondence with rotation of the crank elements; and a second connecting rod actuated by the second of said crank elements and connected to said counterweight to reciprocate it relative to the body structure in correspondence with rotation of the crank elements

and in counterbalancing opposition to the reciprocation of the shoe structure; said first guide means including a track structure and a plurality of rollers guided thereby; said track structure including liner means which in advancing generally parallel to said axis pass along and engage the underside of one of said rollers, and then advance upwardly and past the upper side of another roller in engagement therewith.

2. A tool as recited in claim 1, in which said liner means have a portion at the location of one of said rollers which bears yieldingly against the roller to take up play between the rollers and track structure.

3. A tool as recited in claim 1, in which said liner means have a portion at the location of said last mentioned roller which is bowed downwardly against that roller and exerts yielding force downwardly thereagainst.

4. A portable work abrading or polishing tool comprising a portable body structure; handle means for manipulating said body structure; a shoe structure movable relative to said body structure to abrade or polish a work surface; first guide means guiding the shoe structure for essentially straight line reciprocal movement along a predetermined axis relative to said body structure; a counterweight; second guide means mounting said counterweight movably to said body structure for reciprocal movement relative thereto and essentially parallel to said axis of movement of the shoe structure; a rotary motor mounted to said body structure; two crank elements driven rotatively relative to said body structure by said motor; a first connecting rod driven by a first of said crank elements and connected to said shoe structure to reciprocate the latter in correspondence with rotation of the crank elements; and a second connecting rod actuated by the second of said crank elements and connected to said counterweight to reciprocate it relative to the body structure in correspondence with rotation of the crank elements and in counterbalancing opposition to the reciprocation of the shoe structure; said first guide means including two elongated tracks connected to opposite sides of said shoe structure and forming opposed channels having upwardly facing and downwardly facing flange surfaces, two series of rollers mounted rotatably to opposite sides of said body structure and projecting laterally into said tracks respectively, and two track liner elements in said tracks engaging said rollers; each of said liner elements being an elongated strip of material which is of zigzag configuration to extend along and engage only the upper side of at least one of said rollers and to extend along and engage only the underside of at least one other roller.

5. A portable work abrading or polishing tool comprising a portable body structure; handle means for manipulating said body structure; a shoe structure movable relative to said body structure to abrade or polish a work surface; first guide means guiding the shoe structure for essentially straight line reciprocal movement along a predetermined axis relative to said body structure; a counterweight; second guide means mounting said counterweight movably to said body structure for reciprocal movement relative thereto and essentially parallel to said axis of movement of the shoe structure; a rotary motor mounted to said body structure; two crank elements driven rotatively relative to said body structure by said motor; a first connecting rod driven by a first of said crank elements and connected to said shoe structure to reciprocate the latter in correspondence with rotation of the crank elements; and a second connecting rod actuated by the second of said crank elements and connected to said counterweight to reciprocate it relative to the body structure in correspondence with rotation of the crank elements and in counterbalancing opposition to the reciprocation of the shoe structure; said first guide means including two elongated tracks connected to opposite sides of said shoe structure and forming opposed channels having upwardly facing and downwardly facing flange surfaces, two series of rollers mounted rotatably to opposite sides of said body structure and projecting laterally into said tracks respectively, and two track liner elements in said tracks engaging said rollers; each of said liner elements being an elongated strip of material secured to an associated one of said tracks and which is of a zigzag configuration to extend along and engage only the upper side of at least one of said rollers and to extend along and engage only the underside of at least one other roller; said liner elements having portions engaging the upper sides of some of said rollers which are resilient and bowed downwardly to exert yielding downward force against those rollers.

6. A portable work abrading or polishing tool comprising a portable body structure; handle means for manipulating said body structure; a shoe structure movable relative to said body structure to abrade or polish a work surface; first guide means guiding the shoe structure for essentially straight line reciprocal movement along a predetermined axis relative to said body structure; a counterweight; second guide means mounting said counterweight movably to said body structure for reciprocal movement relative thereto and essentially parallel to said axis of movement of the shoe structure; a rotary motor mounted to said body structure; two crank elements driven rotatively relative to said body structure by said motor; a first connecting rod driven by a first of said crank elements and connected to said shoe structure to reciprocate the latter in correspondence with rotation of the crank elements; a second connecting rod actuated by the second of said crank elements are connected to said counterweight to reciprocate it relative to the body structure in correspondence with rotation of the crank elements and in counterbalancing opposition to the reciprocation of the shoe structure; said shoe structure being a generally flat structure having a cushion at its underside and having clips for securing sandpaper to the shoe structure in a position of extension along its underside; said body structure extending along the upper side of said shoe structure; said first guide means including two channel shaped opposed spaced parallel track elements projecting upwardly at the top of the shoe structure near its opposite sides respectively, a series of rollers mounted rotatably to opposite sides of said body structure and projecting into said tracks to be guided thereby, and two liner elements within said tracks and each of zigzag configuration to extend along and engage only the upper sides of alternate ones of the rollers in a particular track and only the undersides of rollers therebetween; said liner elements having resilient downwardly bowed portions engaging and exerting downwad yielding force against the upper sides of some of said rollers; said motor being carried at the upper side of said body structure and having a rotor mounted to turn about a transverse horizontal axis; said crank elements being

mounted to the upper side of the body to turn about a transverse horizontal axis generally parallel to the axis of said motor; and an endless belt transmitting power from said motor to said crank elements; said body structure containing an opening within which said counterweight is mounted for straight line movement; said second guide means being two tracks contained within said opening of said body structure and slidably guiding said counterweight; said first connecting rod projecting in a first direction from said first crank element to a point of connection to said shoe structure; and said second connecting rod projecting in generally the opposite direction beneath said motor and to a point of connection with said shoe structure.

7. A portable tool for treating a work surface comprising a body structure, a shoe structure movable relative to the body structure to act on the work surface, motor means for driving the shoe structure relative to the body structure, and guide means mounting the shoe structure for its relative movement, said guide means including a track structure, a plurality of rollers movable within said track structure, and liner means within the track structure extending along and engaging only the underside of one roller and only the upper side of another roller.

8. A tool as recited in claim **7**, in which said liner means have a portion at the location of said last mentioned roller which is resiliently urged downwardly thereagainst.

9. A tool as recited in claim **7**, in which said liner means include a strip of resilient material extending along the upper side of said last mentioned roller and bowed downwardly theretoward and away from a downwardly facing surface of said track, and exerting yielding force downwardly against said last mentioned roller.

10. A tool as recited in claim **7**, in which said liner means include an elongated strip of spring material of zigzag configuration shaped to extend along only the underside of said first mentioned roller, and then advance upwardly to extend along only the upper side of said second mentioned roller, and then extend downwardly to pass along and engage only the underside of a third roller, said spring material having a portion which contacts said second mentioned roller and exerts yielding force downwardly thereagainst.

11. A tool as recited in claim **10**, including fasteners detachably securing each of said liner strips to the associated one of said tracks.

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