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(71) Applicant: **WINDSOR INDUSTRIES, INC.**
Englewood, CO 80110 (US)

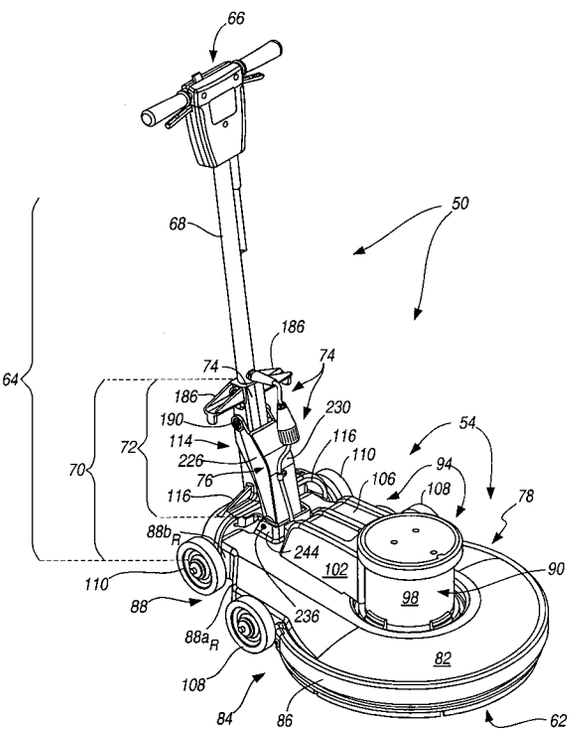
(72) Inventor: **Tran, Loi**
Highlands Ranch, Colorado 80130 (US)

(74) Representative: **Harrison Goddard Foote**
Belgrave Hall
Belgrave Street
Leeds LS2 8DD (GB)

(54) Floor care machine with counter acting force

(57) A floor care machine that includes a deck having a motor, a rotatable floor care element for engaging a floor surface, and a handle apparatus pivotally mounted to the deck is provided. Additionally, there are first and second sets of wheels toward the rear of the deck and on opposite sides of handle apparatus pivot attachment points. In addition to the attachment points, the handle apparatus and the deck are coupled together by a rigid handle link which is pivotally attached to the deck at one end and pivotally attached to the handle apparatus at the other end. The handle link communicates deck pivot forces between the deck and the handle apparatus, and in particular, communicates such forces resulting from a compressing or decompressing of a compressible component provided along the length of the handle apparatus. A tension applied to the compressible component is communicated to the deck as a pivot force that counters deck gravitational and floor suction effects induced by the rotation of the floor care element.

FIG. 1



EP 1 354 548 A2

Description

FIELD OF THE INVENTION

[0001] The present invention relates generally to a floor care machine, and in particular to a floor care machine which automatically maintains a substantially even pressure on the floor by a floor care element attached to the machine.

BACKGROUND OF THE INVENTION

[0002] For operating a floor care machine such as for burnishing, waxing, cleaning or sanding a floor, it is desirable to control the amount of weight the machine places on the contacting pad or other floor care element of the machine in caring for the floor. Such weight control is important in controlling the pressure applied to the floor surface and in controlling the amperage draw of the motor of the floor care machine. Previously, such weight control has been generally accomplished by a floor care machine operator using a fixed handle on the floor care machine to manually determine the amount of pressure being applied to various floor areas. In particular, the operator controlled the floor care element pressure by lifting or pushing on the handle. The problem with this type of operator involvement is the floor care element pressure varies, e.g., because different operators place different pressures on the floor care element and because of operator fatigue as well as operator height. Floor care machines have been disclosed, such as in U.S. Pat. No. 4,658,459 filed Jan. 27, 1986, that include a plurality of torsion springs as an "urging member" for reducing reliance on the operator to provide appropriate floor care element pressure on the floor. However, due to the requirement that the torsion springs had to be preloaded prior to shipment, the floor polishing machine of U.S. Pat. No. 4,658,459 generally could not be sold partially assembled due to the risk of components flying apart during assembly by unskilled persons and/or by persons without the proper assembly tools and jigs. Moreover, the free ends of the torsion spring exert a high compression force on the floor care machine platform. Accordingly, some materials such as rotationally molded plastic may not hold up under such a high compression force without reinforcement. To alleviate this drawback, U.S. Pat. No. 5,674,120 filed September 30, 1996 uses a gas spring instead of torsion springs. The gas spring is pivotally connected at one end to the handle of the machine and is pivotally connected to the body of the machine at its opposite end. The pivot point of the gas spring on the body is different than the pivot point of the machine handle.

[0003] Notwithstanding the different designs that have been advanced for achieving uniform pressure on the floor by a floor care element, it is desirable to provide a floor care machine that is able to provide such uniform pressure, while being cost effective, stylish in appearance and which incorporates all other necessary machine functions.

SUMMARY OF THE INVENTION

[0004] According to a first aspect of the present invention, there is provided a floor care machine, comprising:

a deck;
a floor care element operably joined to said deck;
a handle having a longitudinal center axis and being operably attached to said deck; and
a force system having force generating portions extending in a direction along said longitudinal center axis of said handle for use in applying a force to said deck.

[0005] According to a second aspect of the present invention, there is provided a floor care machine, comprising:

a deck;
a floor care element operably joined to said deck;
a handle apparatus including a handle that is pivotal about a horizontal axis; and
a floor system having force generating portions for use in applying a force to said deck, said force generating portions also pivotal about said horizontal axis.

[0006] According to a third aspect of the present invention, there is provided a method for controlling a position of a floor care element, comprising:

providing a floor care machine including a deck, a floor care element, a handle apparatus having a slot and force generating portions joined to said handle apparatus;
generating at least a first force using said force generating portions; and
applying at least portions of said first force to said deck using a handle link that is offset from said force generating portions in order to counter a suction force when said floor care element is activated, wherein said handle link is joined to said force generating portions using said slot.

[0007] Embodiments of the present invention may provide a floor care machine that provides a coupling or a handle link between the floor care machine body and a handle apparatus which is pivotally mounted to the body. The handle link is part of a force generating system having a resilient compressible component (e.g., a compression spring) along the direction of the length of the handle apparatus, wherein the compressible component and the handle link cooperate for urging the body (or deck) of the floor care machine to pivot about the axis of a first set of wheels and thereby bias the front of

the deck upwardly. The forces for urging the deck to pivot are used to counter balance opposing pivotal forces caused by the weight of the deck and the floor suction forces generated by the rotation of a floor care element that rotationally contacts the floor for administering the desired floor care when the machine is operating.

[0008] Thus, embodiments of the present invention seek to provide a novel machine for the care of floor surfaces.

[0009] Embodiments of the present invention further seek to provide such a novel floor care machine which places a substantially even pressure on the floor surface by the floor care element substantially without regard to the pivotal position of the handle apparatus with respect to the deck of the floor care machine.

[0010] Embodiments of the present invention also seek to provide such a novel floor care machine which places even polishing force on the floor surface by the floor care element regardless of the unevenness of the floor surface.

[0011] Embodiments of the present invention also seek to provide such a novel floor care machine which automatically maintains even polishing pressure.

[0012] Embodiments of the present invention also seek to provide such a novel floor care machine which maintains even floor care element pressure without being dependent on operator involvement.

[0013] Embodiments of the present invention also seek to provide such a novel floor care machine having floor care element pressure which is not variable due to operation by different operators.

[0014] Embodiments of the present invention also seek to provide such a novel floor care machine having floor care element pressure which is substantially not variable due to operator fatigue.

[0015] For a better understanding of the present invention and to show how it may be carried into effect, reference shall now be made by way of example to the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig. 1 shows an exterior perspective view of the floor care machine of the present invention;
Fig. 2 shows a side view of the floor care machine; and
Fig. 3 shows a partially exploded view of the floor care machine thereby illustrating internal components.

[0017] Where used in the various figures of the drawings, the same numerals designate the same or similar parts. Furthermore, when the terms "lower", "upper", "above", and other position related terms are used herein, it should be understood that these terms are to be understood in the contexts and orientations illustrated in the accompanying figures.

DETAILED DESCRIPTION

[0018] An embodiment of the floor care machine 50 is shown in Fig. 1. The floor care machine 50 generally includes a body portion or deck 54 adapted to be moved along a floor 58 (Fig. 2), and, attached to the deck is a floor care element 62 including, e.g., a polishing pad, a brush, a burnishing pad, a sanding disk, a waxing pad, a floor scouring element, or the like which contacts the floor with a rotational motion when the floor care machine 50 is operable. Additionally, the deck 54 has attached thereto a handle apparatus 64 for guiding and controlling the deck 54. The handle apparatus 64 is pivotally attached to the deck 54 at various locations on the deck (as will be described below) so that the handle apparatus can, e.g., pivot between (i) operating positions (wherein the below described handle 68 is generally within a range of 30 to 60 degrees from the horizontal but can be outside that range), and (ii) a transport position (wherein the handle 68 is substantially vertical).

[0019] Among the components included in the handle apparatus 64 are:

(1) an operator grip 66 by which an operator controls the floor care machine 50,
(2) the handle 68 having a length the extends downwardly from the grip 66, wherein the opposite end of the length connects to the assembly 70 described immediately below, and
(3) an assembly or section 70 (Fig. 1, also denoted herein as an "attachment assembly" and "counter force assembly") for both: (i) pivotally attaching the handle apparatus 64 to the deck 54, and (ii) providing a force generating system 72 (or simply force system) for inducing a force which is a counter pivot force to the gravitational and floor suction forces that are generated generally forward of the wheels 108 during operation of the floor care machine 50, wherein these latter two forces urge at least the deck 54 and the floor care element 62 to pivot about the rotational axis of the wheels 108 in a counterclockwise direction in the orientation of Fig. 2. Note that the force system 72 includes:

(1) a force generating device 74 (Fig. 1) that is generally an extension of the handle 68 length further toward the deck 54. The force generating device 74 includes portions, e.g., a compressible resilient component therein for generating forces in the direction of the handle length (e.g., along the axis 118 of Fig. 2 as described hereinbelow) that are used to counter balance the weight of the deck 54 and floor suction forces induced by the rotation of the floor care element 62; and
(2) a substantially rigid handle link 76 for trans-

ferring forces induced by the force generating device 74 to the deck 54 as will be described further hereinbelow.

[0020] The deck 54 also includes a housing 78 which substantially contains the floor care element 62. The housing 78 includes a sloping platform 82 having a downwardly extending skirt 84 about its perimeter, wherein the skirt includes a first skirt portion 86 surrounding the floor care element 62 and a second skirt portion 88 extending rearwardly, e.g., for attaching the handle apparatus 64 thereto (Fig. 3), wherein this second skirt portion includes paired planar sides ($88a_L$, $88a_R$), ($88b_L$, $88b_R$) and a rear skirting 88c (e.g., Fig. 3). A motor 90 is mounted at the center of and generally above the platform 82. Floor care element 62 is operatively connected to motor 90 for rotation thereby and within housing 78.

[0021] The deck 54 further includes a substantially inverted cup-shaped housing or motor shroud 94 received on housing 78 for encasing motor 90. In one embodiment of the present invention, the housing 94 generally includes a cylindrical shaped portion 98 and a generally box shaped portion 102. Portion 102 includes a generally closed top 106, a generally open bottom for receipt and mating on platform 82.

[0022] The floor care machine 50 further includes a first set of wheels 108 having a rotation axis located intermediate between the motor 90 and a second set of wheels 110. When the floor care machine 50 is in an operable position, the first set of wheels 108 is generally at a level equal to or slightly lower than the level of floor care element 62. Note that at least the front two-thirds of the floor care element 62 (i.e., from the 8 o'clock to 4 o'clock position thereof) engages the floor surface 58 when the floor care element 62 is rotated by motor 90, more preferably substantially the entire side of floor care element 62 facing the floor 58 engages or contacts the floor. Moreover, the wheels 108 are rotatably secured to the skirt 84 of the housing 78.

[0023] For attaching the handle apparatus 64 to the deck 54, the counter force assembly 70 includes mounts 116 that extend from the center axis 118 (Fig. 3) of the handle apparatus 64, and span the rear skirting 88c. The mounts 116 are pivotally secured to the deck 54 via an axle 120 (Fig. 3) that is provided through the planar skirting sides $88b_L$ and $88b_R$ and additionally through an axle opening 122 in each mount 116. As mentioned above, the counter force assembly 70 includes force system 72 which, in turn, includes the force generating device 74 that is generally provided along center axis 118 and below the handle 68 (Fig. 1). In particular, the force generating device 74 includes adjacent lower handle sides 130 (Fig. 3) which provide a substantially cylindrical chamber 136 (Fig. 2) therebetween, wherein this chamber extends: (a) from paired chamber end cap halves 142 (only one of which can be seen in Fig. 3) to (b) the brackets 146. Note that the cylindrical chamber 136 has its center axis aligned with the center axis 118 of the handle apparatus 64. Additionally note that each of the lower handle sides 130 has a guide slot 152 extending longitudinally from just below the brackets 146 and toward the end cap halves 142 for approximately 1/3 of the length of the cylindrical chamber 136 in the direction of the center axis 118. Also, in the region 158 (Fig. 3) between the upper end of each guide slot 152 and its corresponding bracket 146, each of the lower handle sides 130 provides for the cylindrical chamber 136 to have a larger radius than the lower portion 160 of the cylindrical chamber 136 (Fig. 2) below the regions 158. Note that the lower end of the handle 68 is secured within the enlarged radius portion provided by the two regions 158 when these regions are secured together by anyone of various securing devices such as bolt assembly 164 (Fig. 3). In particular, the bolt assembly 164 secures the adjacent lower handle sides 130 with the handle 68 by remaining positioned in the bolt holes 168, 172, and 176.

[0024] Provided within the lower portion 160 (and also part of the force generating device 74) are force generating components for inducing the counter pivot force mentioned above. In particular, the counter pivot force is provided by the generation of a force linearly along the center axis 118 by the compression of a compressible component such as compression spring 182. However, it is within the scope of the present invention that another component such as a wave spring or other resilient component may be used in place of compression spring 182, and such resilient components may have different resiliency characteristics depending, e.g., on the desired behavior of the floor care machine 50. Also included in the force generating device 74 and within the lower portion 160 but above the spring 182 is a compression block 186 for compressing the spring 182 within the lower portion 160. Thus, the compression block 186 has a diameter that may be only sufficiently smaller than the diameter of the lower portion 160 so that the compression block can freely slide therein. The compression block 186 is slidably secured to the guide slots 152 by bolt assembly 190 (Fig. 3) also included in the force generating device 74, wherein bolt shaft 194 and sleeve 198 of this bolt assembly securely span both guide slots 152 and the bolt hole 204 of the compression block 186. Also pivotally secured to the bolt shaft 194 and the sleeve 198 is a first end portion 208 (via bolt holes 212) of the handle link 76, wherein the opposite end 220 of the handle link pivotally attaches to the deck 54 as will be described hereinbelow. As can be seen in Fig. 1, side flanges 226 and the cross member 230 of the handle link 76 fit over the lower portion 160.

[0025] Regarding the opposite end 220 of the handle link 76, this end is pivotally secured to the deck 54, and when the angular orientation between the handle apparatus 64 and the deck 54 changes, each end 208 and 220 of the handle link 76 pivots in a manner such that bolt assembly 190 changes position in the guide slots

152. Thus, when the angle between the handle 68 and any horizontal surface of the deck 54 decreases (e.g., decreases toward 90 degrees), then the bolt assembly 190 is urged toward the upper end of the guide slots 152 and the spring 182 is decompressed. Alternatively, when the angle between the handle 68 and such an horizontal surface increases (e.g., toward 180 degrees), then the bolt assembly 190 is urged toward the lower end of the guide slots 152 and accordingly compresses spring 182.

[0026] More specifically, the end 220 is pivotally attached to the deck 54 (by pin subassembly 236 having components identified by the same label) within a raised enclosure 244 of the deck. Thus, if during operation the operator changes the angle of the handle apparatus 64 relative to the horizontal, such a change will induce a linear movement of the bolt assembly 190 (and also the spring 182 and compression block 186) within the lower portion 160, and there will be a responsive movement by the handle link 76 which will cause the pressure exerted by the rotating floor care element 62 to at least temporarily change due to a pivoting force of the deck 54 about the axle 120. Conversely, if during operation the deck 54 is moved, e.g., over a portion of the floor 58 that abruptly rises or falls, then the deck 54 is likely to pivot about the axle 120, and there will be a corresponding responsive pivoting of the handle link 76 on the pin subassembly 236 and a repositioning of the handle link end 208 along the axis 118 which will, in turn, induce movement in the bolt assembly 190 (and also the spring 182 and compression block 186) within the lower portion 160. Note that induced responses in the deck 54 to movement in the handle apparatus 64 (or visa versa) are dampened depending on, e.g., the compression and resiliency characteristics of the spring 182. For example, a spring 182 requiring very high forces for compressing will cause the handle link 54 to move more similarly to having its end 208 remain in a constant pivot position along the axis 118 and thus any angular change (relative to the horizontal) between the handle apparatus 64 and the deck 54 will be substantially fully communicated between these two assemblies. However, if spring 182 requires very small forces for compression, then an angular change (relative to the horizontal) between the handle apparatus 64 and the deck 54 will for the most part not be communicated from one of these two assemblies to the other. Accordingly, by adjusting compression characteristics of the spring 182 (e.g., by expanding or decreasing its range of movement within the chamber 136), or replacing the spring with a different spring, the responsiveness of the floor care machine 50 to angular changes between the handle apparatus 64 and the deck 54 can be changed.

[0027] Substantially within the confines of the raised enclosure 244 there is also a collection of components that function as a latch mechanism for latching the handle apparatus 64 into a substantially vertical position for storing the floor care machine when not in use (e.g., inactivated). The collection of components for the latch mechanism includes a torsion spring 254 (Fig. 3) disposed on the pin subassembly 236 for biasing the handle link 76 (and accordingly, the handle 68) to pivot clockwise (in the orientation of Fig. 2) about this pin subassembly toward a position for operating the floor care machine 50 rather than storing it. Accordingly, when storing the floor care machine 50, the handle apparatus 64 is rotated to a substantially vertical position by overcoming the bias of the torsion spring 254 and causing the latching mechanism to secure the handle apparatus 64 in the substantially vertical position. Additionally the collection of components for the latch mechanism includes a latch 258 (Fig. 3) pivotally provided on the pin subassembly 236 and within the raised enclosure 244 for receiving a latch striker 262 provided on the end of the handle apparatus 64 opposite from the grip 66. Note that the latch 258 and the latch striker 262 cooperate to secure the handle apparatus 64 in a substantially vertical position for storing the floor care machine 50.

[0028] In operation of at least one embodiment of the floor care machine 50, the wheels 110 are positioned at a level slightly above the level of the floor care element 62. In one embodiment, the wheels 110 are in the range of ½ to ¾ of an inch above the level of wheels 108. Moreover, the force system 72 may induce pivoting forces at the axle 120 that: (a) are counter pivot forces to the gravitational and floor suction forces which the deck 54 exerts about the axle 120, and (b) reduce the possibility of (or the degree to which) the floor care element 62 unevenly or differently contacts the floor when, e.g., undulations in the floor 58 are encountered, and/or different handle apparatus 64 orientations are used by different floor care machine operators. Thus, regarding different operators, for a tall operator having the handle apparatus 64 at substantially a constant 50 degrees, and for a short operator having the handle apparatus 64 at substantially a constant 35 degrees, both operators can cause the floor care element 62 to exert substantially the same pressure on the floor 58 during operation of the floor care machine 50. However, in order for the force system 72 to achieve the advantages of (a) and (b) immediately above, the spring 182 (or other compressible component) must be matched to the weight and suction forces generated by the deck 54. In general, for many springs 182 there is a non-trivial range of angles relative to the horizontal wherein there is only a slight variation in the linear force generated by the spring 182. For example, such a range can correspond to the handle apparatus 64 varying between 35 degrees to 50 degrees from horizontal (i.e., counter clockwise in Fig. 2). However, beyond such a range, the linear force generated by the spring 182 may commence to vary noticeably, and such variation can be beneficial in that an operator can then explicitly cause the floor care element 62 to vary its pressure on the floor 58 to correspond to different floor conditions such as, e.g., exceptionally soiled areas of the floor 58.

[0029] After transporting the floor care machine 50 from storage to the floor 58 location for which care is desired, the latch striker 262 is disengaged from the latch 258 allowing handle apparatus 64, including handle 68 and the force generating portions 74, such as the compression spring 182, to be pivotal with respect to the deck 54 about pivot pin subassembly 236 and axle 120. It can then be appreciated that torsion spring 254 biases the handle apparatus 64 from a substantially vertical position and towards an angled position (e.g., 45 degrees) with respect to horizontal. When the handle apparatus 64 is lowered into its operating position as shown in Fig. 2, handle apparatus 64 creates a load on the spring 182. This load or force translates into a clockwise pivot force on the wheels 108 (in the orientation of Fig. 2) so that there is a downward force to the rear of platform 82 which, in turn, causes an upward lift to the front of platform 82.

[0030] It should also be appreciated that without activation of motor 90 rotating floor care element 62 and with handle apparatus 64 in an operating position, deck 54 will pivot about wheels 108 such that the forward portion of deck 54 and of floor care element 62 is raised above the floor 58 since there is no floor suction force being provided at the front of the floor care machine 50. Moreover, an operator can then tilt the floor care machine 50 back so that it can be moved on both sets of wheels 108 and 110 between, e.g., different floor areas and/or to/from storage.

[0031] It can now be appreciated that the wheels 110 of the floor care machine 50 perform a dual function. First, they limit the amount of upward movement of the front of floor care element 62 under the bias of the force generating portions 74 and thus insure that a partial vacuum is created when floor care element 62 is initially rotated to create the suction effect for pulling the front of floor care element 62 downward. Secondly, the wheels 110 serve as transport wheels when floor care machine 50 is being moved between locations.

[0032] Thus since the invention disclosed herein may be embodied in other specific forms without departing from the general characteristics thereof, some of which forms have been indicated, the embodiments described herein are to be considered in all respects illustrative and not restrictive. The scope of the invention is to be indicated by the appended claims, rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are intended to be embraced therein.

[0033] The preferred features of the invention are applicable to all aspects of the invention and may be used in any possible combination.

[0034] Throughout the description and claims of this specification, the words "comprise" and "contain" and variations of the words, for example "comprising" and "comprises", mean "including but not limited to", and are not intended to (and do not) exclude other components, integers, moieties, additives or steps.

Claims

1. A floor care machine, comprising:

a deck;
a floor care element operably joined to said deck;
a handle having a longitudinal center axis and being operably attached to said deck; and
a force system having force generating portions extending in a direction along said longitudinal center axis of said handle for use in applying a force to said deck.

2. A floor machine, as claimed in claim 1, wherein:

said force system includes a handle link joined to said deck and said handle link applies said force to said deck.

3. A floor machine, as claimed in claim 2, wherein:

said handle link has first and second portions and with said first portion being joined to said deck and said second portion being joined to at least one of said handle and said force generating portions.

4. A floor machine, as claimed in claim 1, wherein:

said force system is part of a counter force assembly that includes a mount extending from said force system and being joined to said deck.

5. A floor machine, as claimed in claim 4, wherein:

said counter force assembly, said force generating portions and said handle are part of a handle apparatus.

6. A floor machine, as claimed in any preceding claim, wherein:

said force generating portions generate a force in a substantially linear direction.

7. A floor machine, as claimed in any preceding claim, wherein:

said force generating portions include at least one of the following: a resilient component, a compression spring, a wave spring, and a moving part.

8. A floor machine, as claimed in any preceding claim, wherein:

said handle has a stored position and at least

first and second operating positions, wherein when said handle is in said stored position, said handle is substantially vertical and the floor care element is inactivated, and when said handle is in each of a selected one of said first and second operating positions, said handle is different from vertical and said floor care element is activated and in which the force produced by said force generating portions is different between said first and second unstored positions.

9. A floor machine, as claimed in any preceding claim, further including:

a latch mechanism for holding said handle in a stored position, said latch mechanism including a torsion spring used to maintain said handle in an unstored position and which is overcome when said handle is in said stored position.

10. A floor machine, as claimed in any preceding claim, wherein:

said handle pivots about a horizontal axis and said force generating portions also pivot about said horizontal axis.

11. A floor machine, as claimed in claim 10, wherein:

said force generating portions includes at least one of a compression spring and a wave spring.

12. A floor machine, as claimed in any preceding claim, wherein:

said force system includes a handle link joined to said deck adjacent to one end of said handle link and joined in a slot in said handle adjacent an opposite end of said handle link and with said opposite end of said handle link being used to move said force generating portions.

13. A floor care machine, comprising:

a deck;
a floor care element operably joined to said deck;
a handle apparatus including a handle that is pivotal about a horizontal axis; and
a floor system having force generating portions for use in applying a force to said deck, said force generating portions also pivotal about said horizontal axis.

14. A floor care machine, as claimed in claim 13, wherein:

said deck is connected to a first set of wheels and a second set of wheels and in which said second set of wheels is located closer to said handle apparatus than is said first set of wheels and in which said second set of wheels is joined to said deck along said horizontal axis.

15. A floor care machine, as claimed in claim 13 or 14, wherein:

said handle has a longitudinal center axis and said force generating portions include a spring that can be compressed and in which said spring is positioned along said longitudinal center axis.

16. A floor care machine, as claimed in any one of claims 13 to 15, wherein:

said handle has a slot and said floor system includes a handle link with first and second ends, said handle link being joined to said deck adjacent said first end and said handle link being joined to said handle slot adjacent to said second end.

17. A floor care machine, as claimed in claim 16, wherein:

said handle link extends offset from said longitudinal center axis.

18. A method for controlling a position of a floor care element, comprising:

providing a floor care machine including a deck, a floor care element, a handle apparatus having a slot and force generating portions joined to said handle apparatus;
generating at least a first force using said force generating portions; and
applying at least portions of said first force to said deck using a handle link that is offset from said force generating portions in order to counter a suction force when said floor care element is activated, wherein said handle link is joined to said force generating portions using said slot.

19. A method, as claimed in claim 18, wherein:

said force generating portions include a spring that can be compressed and said generating step includes compressing said spring when said handle apparatus is moved to at least a first operating position.

20. A method, as claimed in claim 18, wherein:

said force generating portions include one of a compression spring and a wave spring and said generating step includes compressing said one of said compression spring and said wave spring by movement of said handle apparatus and said handle link.

21. A method, as claimed in any one of claims 18 to 20, wherein:

said handle apparatus has a longitudinal center axis and includes a handle and in which force generating portions are disposed along said longitudinal center axis and said generating step includes generating said first force substantially along said longitudinal center axis.

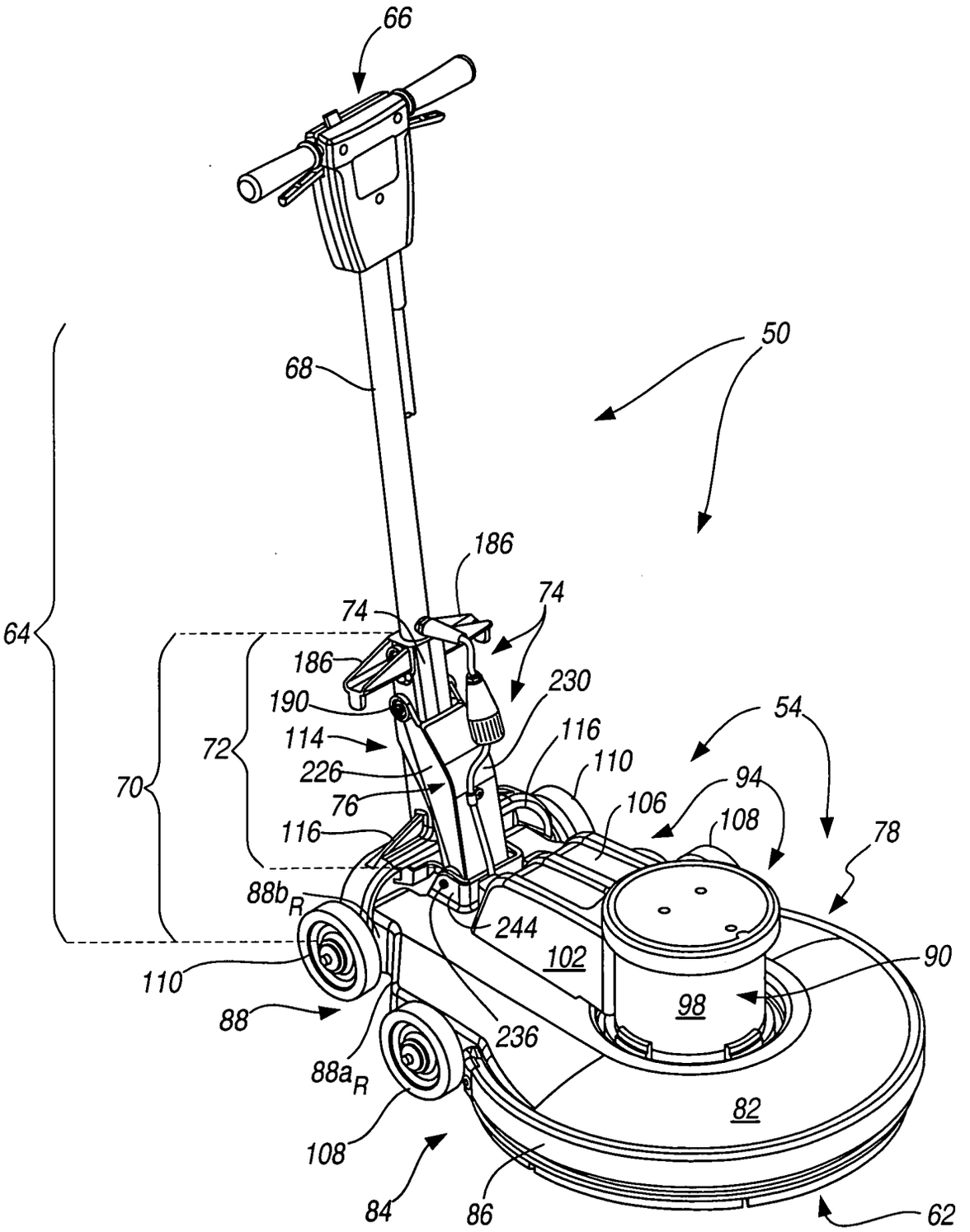
22. A method, as claimed in any one of claims 18 to 20, wherein:

said handle apparatus has a longitudinal center axis and includes a handle and said generating step includes generating said first force substantially along said longitudinal center axis.

23. A method, as claimed in any one of claims 18 to 22, further including:

pivoting said handle apparatus and said force generating portions about the same horizontal axis.

FIG. 1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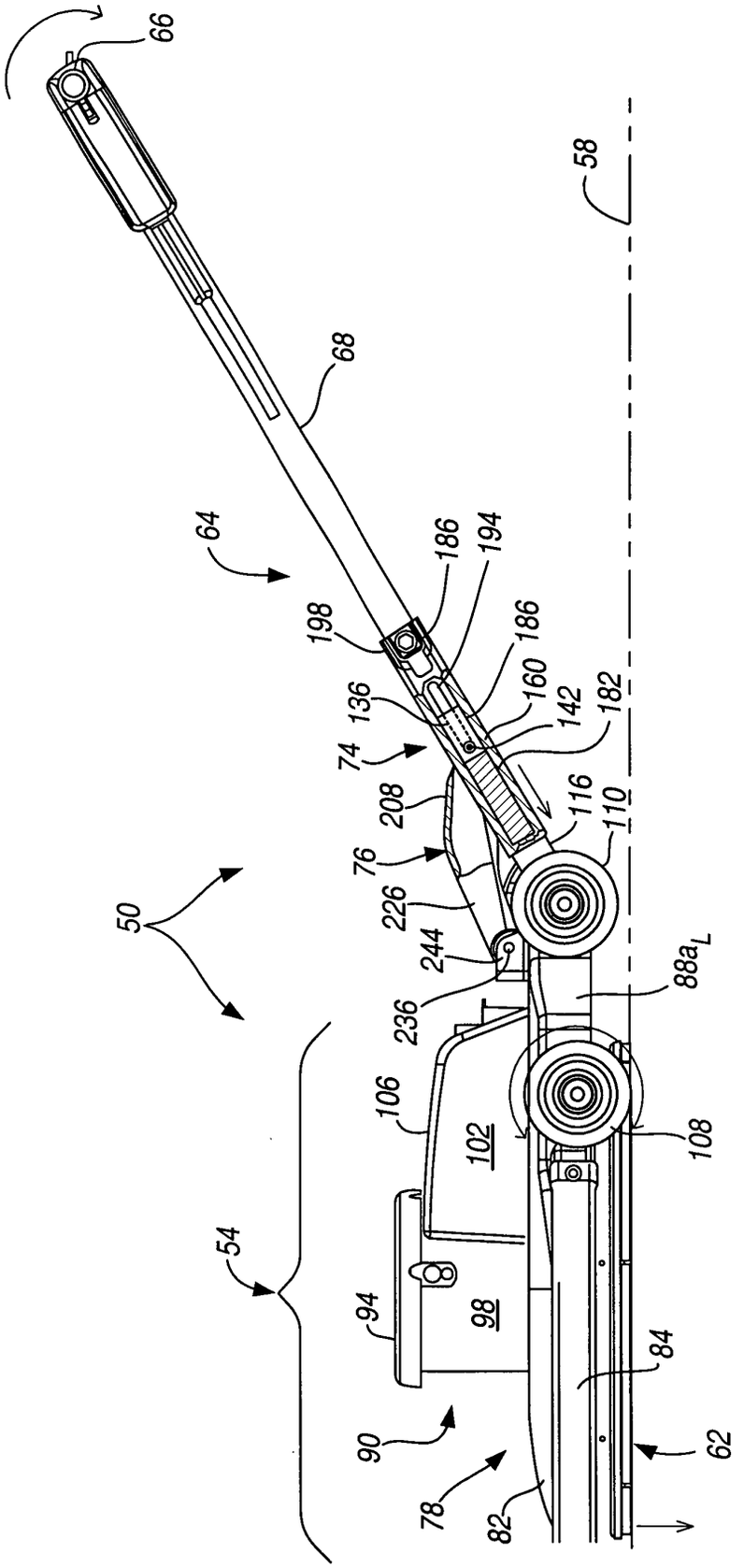
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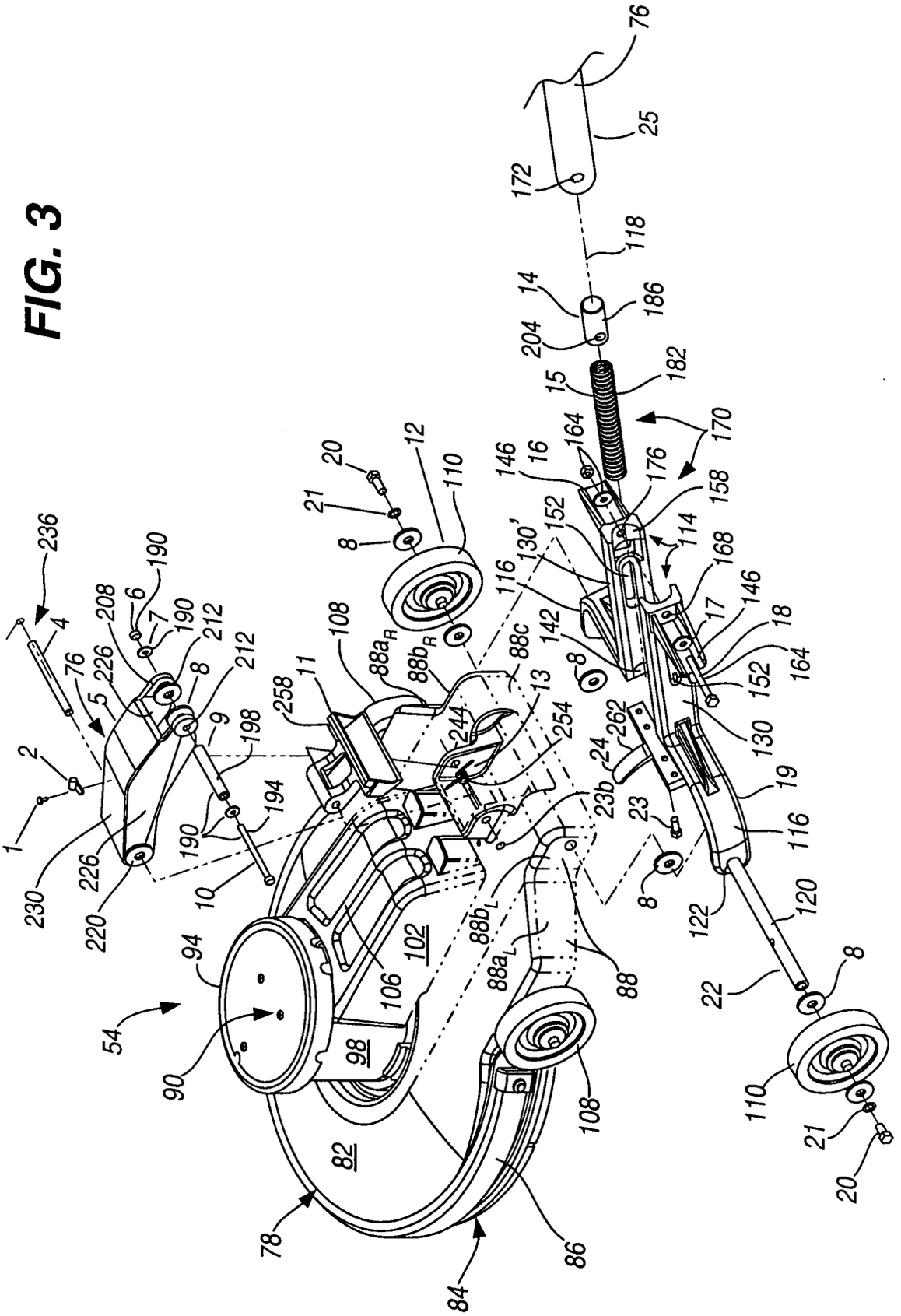
FIG. 2

FIG. 3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