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(54) **Engine shroud**

(57) A machine (10) is provided that includes an engine (40) that rotates an operating member (46). Each of the engine and the operating member is supported on a frame that supports each of the engine and the operating member. A shroud (50) is mounted to the frame independently of the engine and the operating member and the shroud substantially encloses at least a portion of the engine.

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Description

BACKGROUND

[0001] The present invention relates to portable machines with fuel powered engines, and specifically to portable pressure washers with fuel powered engines.

[0002] One side effect of using a fuel powered engine to operate a pressure washer is that the engine generates a significant amount of heat during operation due to the combustion process. This generated heat causes the engine's exterior surfaces to become extremely hot during operation such that a user could easily become burned if directly contacting an exposed engine surface. Prior art pressure washers have used various covers or shrouds to enclose the engine to prevent users from contacting the engine. Because the covers are generally attached directly to the surface of the engine, the cover must be manufactured from a material with specific properties that allow the cover to accept the significant amount of heat transferred to it from the engine, or in the alternative, the dimensions of the cover (i.e. the thickness of the cover) must be such that the cover can accept the amount of heat generated and transferred to the cover.

[0003] Because covers for pressure washers must be robust enough to accept a significant amount of heat from an engine, it is often a design challenge to provide structures or components to store external tools that may be used with the pressure washer. Many current pressure washers have been designed to include a plurality of clips, rings, or other structures to retain external tools for use with the pressure washer, such as lances, spray guns, cords, nozzles, etc. The structures provided to store these tools is often attached to the handle, the cart, or other working parts of the pressure washer. Storing external components on these portions of the pressure washer makes the pressure washer bulkier and less maneuverable with the external tools installed than many users would prefer.

[0004] Because of heat or vibrational concerns, many previous shrouds that were mounted directly to the engine could not be formed to accept and retain external tools because of material considerations. Specifically, shrouds or covers that are mounted on an engine receive a significant amount of heat from the engine during operation and accordingly reach dramatically higher temperatures. Accordingly, shrouds were often manufactured with relatively thick or relatively heat resistant materials to withstand the increased temperatures. The design requirements for previous shrouds that were directly connected to an engine often prevented the shroud from including structures that were movable or had sufficient elasticity to accept and retain a tool such as a spray gun.

[0005] Additionally, shrouds that are directly mounted to an engine receive a portion or percentage of any vibrations created by the engine or pump during operation. Any external tools that are attached to the shroud receive any vibrations within the shroud and may become at least partially unstable with respect to the shroud during pressure washer operation. This unstable connection could lead to failure or breakage of the structures used to removeably accept the external tools, which reduces the operability and convenience of operating the pressure washer. Additionally, the relative movement between the vibrating shroud and the external tools during operation (because the external tools do not vibrate with the same harmonic frequency as the shroud because of their inertia) may create additional unpleasant noise, which often serves as a distraction and an annoyance to the user.

BRIEF SUMMARY

[0006] A pressure washer is provided that includes an engine that is operatively connected to a pump. Each of the engine and the pump are supported on a frame. A shroud is mounted to the frame independently of the engine and the pump wherein the shroud at least partially surrounds and encloses a portion of the engine.

[0007] In a first aspect the invention provides a pressure washer comprising (a) an engine that is operatively connected to a pump, (b) a frame that supports each of the engine and the pump; and (c) a shroud mounted to the frame independently of the engine and the pump, wherein the shroud at least partially encloses the engine.

[0008] The shroud may further comprise a plurality of vents to define an air flow passage to and from the engine. It may be mounted to the frame with at least one dampener to limit vibrations generated by the pump and the engine. The shroud may be of plastic, and the dampeners of rubber, with the shroud mounted to the frame at discrete locations. The engine and pump may also be mounted to the frame with at least one dampener to limit vibrations transferred to the frame.

[0009] The shroud may comprise at least one retainer to receive and support tools for use with the pressure washer, which may be integrally formed with the shroud, or separately formed.

[0010] It may be arranged that the shroud substantially encloses the engine and pump. Moreover, the shroud may be arranged to not contact the engine or the pump when attached to the frame.

[0011] In a further aspect the invention resides a machine comprising (a) an engine that rotates an operating member, (b) a frame that supports each of the engine and the operating member; and (c) a shroud mounted to the frame independently of the engine and the operating member, wherein the shroud substantially encloses a portion of either the engine or the operating member.

[0012] The machine may be for a variety of purposes, such as a generator or air compressor.

[0013] In a still further aspect the invention resides in a pressure washer comprising (a) an engine that is operatively connected to a pump, b) a frame that supports each of the engine and the pump, and (c) a shroud mounted to the frame independently of the engine and the pump with structure to limit the vibrations produced in the en-

gine or the pump, wherein the shroud at least partially encloses the engine and includes at least one retainer to accept and retain a tool for use with the pressure washer.

[0014] Advantages of the present invention will become more apparent to those skilled in the art from the following description of the preferred embodiments of the invention that have been shown and described by way of illustration. As will be realized, the invention is capable of other and different embodiments, and its details are capable of modification in various respects. Accordingly, the drawings and description are to be regarded as illustrative in nature and not as restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The features and advantages of the present invention may be better understood by reference to the accompanying drawings in which like reference numerals refer to like elements.

[0016] FIG. 1 is a perspective view of a pressure washer of the present invention.

[0017] FIG. 2 is the perspective view of FIG. 1 showing the pressure washer without the external tools attached to the shroud.

[0018] FIG. 3 is a perspective exploded view of the shroud and external tools.

[0019] FIG. 4 is a right side view of the pressure washer of FIG. 1.

[0020] FIG. 5 is a front side view of the pressure washer of FIG. 1.

[0021] FIG. 6 is a top view of the pressure washer of FIG. 1.

[0022] FIG. 7 is a back view of the pressure washer of FIG. 1.

[0023] FIG. 8 is a perspective view of a second embodiment of the pressure washer of the present invention.

[0024] FIG. 9 is an exploded view of the pressure washer of FIG. 8.

DETAILED DESCRIPTION

[0025] While this invention is susceptible of several different embodiments, this specification and the accompanying drawings disclose only some specific forms as examples of the invention. The invention is not intended to be limited by the descriptions in this specification or the drawings. Instead, the scope of the invention is provided in the claims.

[0026] Referring now to the figures, a shroud for a machine is provided. The shroud described below can be implemented with a multitude of different types of machines that include engines to operate a working member to perform a specific task. Additionally, the shroud described below may be implemented on various machines that include fuel powered engines, such as pressure washers, generators, or air compressors. Although the invention may be implemented with a variety of different types of machines, the design is fully described with specific references to use in a pressure washer. For the sake of brevity we do not fully describe the use of this concept with other types of machines although one of skill in the art, after fully reviewing the specification and drawings herein, will comprehend that this disclosure may successfully be implemented with other types of machines.

[0027] Turning now to FIG. 1, a pressure washer 10 is provided. The pressure washer 10 is used to receive liquid at a relatively low pressure and raise the pressure using a pump 46, or similar device, until the liquid pressure is such that the liquid may be projected from a spray gun 92, or similar device, at a high rate of speed and pressure. The liquid projected from the pressure washer 10 may be used for various operations. Often, pressure washers are located on a wheeled cart or other movable apparatus to allow the pressure washer to be transported to remote locations for use. The pump 46 on a pressure washer is often operated by a fuel powered engine 40 that includes a rotating drive shaft that is coupled with the pump 46 to rotate a pump impeller (not shown). In some embodiments, the fuel powered engine 40 may be an internal combustion engine.

[0028] As understood by those of ordinary skill in the art, a fuel powered engine generates a large amount of heat during operation due to fuel combustion. While engines are provided with mechanisms for cooling, such as fins 42 and air flow (whether forced or natural circulation) past the external surfaces of the engine, these cooling mechanisms are not normally efficient enough to prevent the exterior surfaces of the engine 40 from dramatically increasing in temperature during engine operation. Accordingly, because the engine 40 is at an increased temperature during operation, the excess heat present on the exterior surfaces of the engine is transferred to neighboring components due to radiation and convection heat transfer, and transferred to components that are in contact with the engine surface due to conduction heat transfer. Therefore, components of the pressure washer that are in contact with or simply in close proximity to the engine 40 experience a significant amount of heat from the engine 40 during operation and accordingly reach higher temperatures during engine operation.

[0029] The engine 40 and associated components such as the fuel tank 14 and the pump 46 are normally rigidly mounted on the frame 60. The frame 40 additionally serves as the mounting point for a pair of wheels 12, a plurality of stops 13, a handle 14, and a shroud or cover 50. The wheels 12 may be mounted independently of each other to the frame, or in other embodiments, the wheels may rotate together on an axle (not shown) that is rotatably mounted to the frame 60. The handle 14 serves as the structure to manipulate when moving the pressure washer 10.

[0030] The frame 60 may be formed from metal and may preferably be formed with hollow metal tubing for high suitable strength but limited weight and material requirements. As shown in the figures, the frame 60 in-

cludes a vertical rear section 62, a bottom section 63, and a top section 64. The rear section 62 includes two vertical posts 62a and a horizontal cross-member 62b (FIG. 7). The wheels 12 rotate about axles that are rotatably mounted to each of the vertical posts 62a. The rear section 62 additionally includes a handle 14 that is collapsible into the vertical posts 62a and can be locked in the extended position shown in the figures with a knob 14b on each vertical post 62a.

[0031] The bottom section 63 includes two arms 63a, each extending from a respective one of the vertical posts 62a. The bottom section 63 additionally includes a front cross-member 63b that connects the two arms 63a and is at substantially the same height as the cross-member 62b of the rear section 62. Finally, the top section 64 includes two arms 64a that extend from one of the two vertical posts 62a of the rear section 62. The arms 64a extend substantially perpendicularly from the vertical posts 62a and curve slightly downward as they project toward the front end of the machine. The two arms 64a are connected at the front end with a cross-member 64b.

[0032] A mounting plate 65 may be attached to the cross-member 62b of the rear section and the cross-member 63b of the bottom section 63. The mounting plate 65 accepts and stabilizes the engine 40 above the mounting plate (and below the top section 64 of the frame 60) and includes an aperture (not shown) to operatively connect the pump 46 with the engine 40. The pump 46 extends from the engine 40 below the mounting plate 65a. As shown in FIG. 1, the mounting plate 65 is mounted to the frame 60 with a plurality of fasteners 66. Additionally, the forward and rear ends 65a, 65b (FIG. 7) of the mounting plate 65 are curved to match the curvature of the frame 60 for a stable connection. Additionally, dampening material (not shown), such as rubber, may be positioned between the mounting plate 65 and the frame 60 to attenuate any vibrations present in the mounting plate 65 from the engine 40 or pump 46 to reduce their transfer to the frame. Additionally, the dampening material may have a relatively high thermal conductivity to substantially prevent heat in the mounting plate 65 from transferring to the frame 60 through conduction.

[0033] The shroud 50 is mounted to the frame 60 independently of the engine 40 and the pump 46. The shroud 50 is provided on the pressure washer 10 to at least partially enclose the engine 40 to provide a protective barrier against accidental contact with the engine 40 during operation that could lead to burns or other injuries. As shown in FIG. 1, the shroud 50 is located above the engine 40 and is mounted to the frame 60.

[0034] The shroud 50 is mounted directly to the frame 60 and does not contact the engine 40 or any associated components. As can be understood by those of ordinary skill in the art, because there is no direct connection contact between the engine 40 and the shroud 50, there is no direct path for conduction heat transfer between the two components. This significantly reduces the amount of heat that can be transferred to the shroud 50, and accordingly reduces the maximum temperature of the shroud during pressure washer 10 operations.

[0035] The shroud 50 may be mounted to the frame 60 at multiple locations to increase the stability of the shroud 60. As best shown in FIG. 2, the shroud 50 has a plurality of extending flanges 58 that provide the connection with the frame 60. As shown, the flanges 58 may have a curved bottom surface or profile to closely contact the curved frame 60. Each flange 58 has an aperture 58a (FIG. 3) to accept a fastener for insertion into a corresponding hole in the frame 60.

[0036] A dampener 62, such as a layer of rubber or other similar material, may be provided between the frame 60 and the shroud 50 at each mounting location. This dampener 62 attenuates or substantially prevents the transfer of heat from the frame 60 to the shroud 50 (and vice versa), and also substantially prevents the transfer of any vibrations that may be present in the frame 60 from transferring to the shroud 50 (and vice versa). Accordingly, because the dampeners 62 attenuate or substantially prevent the transfer of heat and vibrations from the frame to the shroud 50, the shroud 50 can be designed and manufactured with a broader range of shapes, sizes, and materials than would be possible if the shroud 50 reached higher temperatures during pressure washer 10 operation or if the shroud 50 was subject to vibrations of a larger magnitude.

[0037] As best understood with reference to FIGs. 1-3, the shroud 50 may include a plurality of receptacles 56 to accept and retain tools for use with the pressure washer 10. Specifically, the shroud 50 may include a hole 55a for receiving a spray gun 92, a receptacle 56a for a lance 94, and a plurality of receptacles 56c to receive spray nozzles 96. As shown in FIG. 3, the spray gun 92 may include a projection 92a that may be inserted into the hole 55a in the shroud to connect the spray gun 92 to the shroud 50. Additionally, a receptacle 56a may be provided that includes a plurality of fingers 56b to retain the lance 94. As can be understood, the spray gun 92 can be retained by the shroud 50 using a similar receptacle 56a as shown in FIG. 3. The receptacle 56a may be threaded or otherwise inserted into a second hole 55a in the shroud, or in other embodiments the fingers 56b of the receptacle may be monolithically formed with the shroud 50.

[0038] As best shown in FIG. 3, a plate 54 may be provided to hold a plurality of nozzles 96. The plate 54 includes a plurality of holes 54a that receive the male ends of the nozzles 96 and a plurality of retaining apertures 54b that are engageable with fingers 53 on the shroud 50 to retain the plate 54 on the shroud 50. In this embodiment, the plate 54 is easily and quickly removable from the shroud 50 for convenient use at the worksite. In other embodiments, the plate 54 may be monolithically formed with the shroud 50. In other embodiments, the shroud 50 may include additional or alternate receptacles 56 for other tools or components for use with the pressure washer 10, or another type of machine that uses a similar

shroud 50. The receptacles 56 may be integrally formed with the shroud 50, or may be attached to the shroud 50 after the shroud 50 is formed.

[0039] The shroud 50 may be formed from various materials. The shroud 50 may be formed from plastic and integrally mounted in a single piece. The shrouds 50 that are manufactured from plastic may be conveniently and inexpensively molded as a single component in the desired shape. As is known to those of ordinary skill in the art, plastic has a relatively low thermal conductivity. Additionally, plastic can be molded to be relatively elastic, which is useful for receptacles 56 that receive some of the pressure washer tools. For example, as shown in FIGs 1-3, the receptacles 56a for receiving the lance 94, may be formed from opposing arms 56b that partially surround the outer volume of a portion of the tool when positioned within the arms 56b. The arms 56b of the receptacles 56a must be sufficiently flexible because they are biased away from each other to insert the tool into the receptacle 56a and return to their normal orientation when the tool is fully inserted within the receptacle 56a. In other embodiments, the shroud 50 may be formed from metal or other acceptable materials.

[0040] In addition to providing a plurality of receptacles 56a, 56b, the shroud may include a plurality of vents 70 to allow air flow through the shroud 50 to interact with the engine 40. The vents 70 formed on the shroud 50 may be positioned to allow inlet and exhaust air to flow to and from the engine in conjunction with the combustion process. Additionally, vents 70 may be used to allow air flow past the engine 40 during operation (either by natural or forced air circulation) to remove heat by convection. As can be understood, the vents 70 can be integrally formed in the shroud 50 when formed as a molded plastic piece. Alternatively, the vents 70 can be formed in the shroud 50 after the initial formation of the shroud 50 in an independent step for shrouds 50 that are formed from metal or another similar material.

[0041] A second representative embodiment of the machine is shown in FIGs. 8 and 9. Specifically, these figures show a second pressure washer 100. The pressure washer 100 includes all of the components discussed with respect to the first embodiment above, but substantially encloses the motor 140 (FIG. 9) and the pump (not shown) with a shroud or cover 150.

[0042] The shroud 150 is formed from multiple pieces, a front member 151, right and left sides 152, 153, a top member 154, and a rear member 155. As shown in the exploded view of FIG. 9, the left and right sides 152, 153 are attached to the frame 160 with fasteners 180 that are inserted through holes in the shroud members and into holes 161 in the frame. The top and rear members 154, 155 are mounted to the left and right sides 152, 153 after they are mounted to the frame 160. The front member 151 is mounted to a front cross-member 164 of the frame 160 and is kept rigidly mounted to the pressure washer with the left and right sides 152, 153. Accordingly, the shroud is mounted to the frame 160 and does not contact the engine 140 or the pump. Therefore, the pressure washer of this embodiment includes the advantages of the previous embodiment. Specifically, there is no path for direct conduction heat transfer between the engine 140 and the shroud 150. Additionally, because the shroud 150 is not directly attached to the engine 140, vibrations are not directly transferred to the shroud, which allows for quieter and more stable operation of the pressure washer. As with the embodiment above, in this embodiment, a dampening material may be positioned between the frame and the sides of the shroud 150 to attenuate the transfer from any vibrations in the frame to the shroud 150.

[0043] As with the embodiment discussed above, the shroud 150 may include a plurality of structures 156 for receiving tools for use with the pressure washer 100. Specifically, the shroud may receive a spray gun 92 and a lance 94 as well as a plurality of nozzles 96. Additionally, the shroud 150 includes a plurality of vents 170 along the sides and top of the shroud 150 to allow air flow past the engine 140 (that is substantially enclosed within the shroud 150) for cooling as well as air flow for use with the combustion process.

[0044] The foregoing disclosure is the best mode devised by the inventors for practicing this invention. It is apparent, however, that apparatus incorporating modifications and variations will be obvious to one skilled in the art. Inasmuch as the foregoing disclosure is intended to enable one skilled in the pertinent art to practice the instant invention, it should not be construed to be limited thereby but should be construed to include aforementioned obvious variations and be limited only by the scope of the following claims.

[0045] It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, that are intended to define the scope of this invention.

Claims

1. A pressure washer comprising:

   (a) an engine that is operatively connected to a pump;
   (b) a frame that supports each of the engine and the pump; and
   (c) a shroud mounted to the frame independently of the engine and the pump, wherein the shroud at least partially encloses the engine.

2. The pressure washer of claim 1 wherein the shroud substantially encloses the engine and the pump.

3. The pressure washer of claim 1 or 2 wherein the shroud further comprises a plurality of vents to define an air flow passage to and from the engine.

4. The pressure washer of any one of claims 1 to 3 wherein the shroud is mounted to the frame with at least one dampener to limit vibrations generated by the pump and the engine.

5. The pressure washer of claim 4 wherein the dampeners are rubber.

6. The pressure washer of any preceding claim wherein the shroud is plastic.

7. The pressure washer of any preceding claim wherein the shroud is mounted to the frame at a plurality of discrete locations.

8. The pressure washer of any preceding claim wherein the engine and the pump are each mounted to the frame with at least one dampener to limit vibrations transferred to the frame.

9. The pressure washer of any preceding claim wherein the shroud further comprises at least one retainer to receive and support tools for use with the pressure washer.

10. The pressure washer of claim 9 wherein the at least one retainer is integrally formed with the shroud.

11. The pressure washer of claim 9 wherein the at least one retainer is formed separately from the shroud and connected to the shroud.

12. The pressure washer of any preceding claim wherein the shroud does not contact the engine or the pump when attached to the frame.

13. A machine comprising:

(a) an engine that rotates an operating member;
(b) a frame that supports each of the engine and the operating member; and
(c) a shroud mounted to the frame independently of the engine and the operating member, wherein the shroud substantially encloses a portion of either the engine or the operating member.

14. The machine of claim 13 wherein the shroud has at least one vent to define an air flow passage to and from the engine from outside the shroud.

15. The machine of claim 13 or 14 wherein the shroud is mounted to the frame with structure to attenuate the vibrations generated by the engine and the operating member.

16. The machine of any one of claims 13 to 15 wherein the shroud further comprises at least one retainer to receive and support tools for use with the machine.

17. The machine of claim 16 wherein the at least one retainer is integrally formed with the shroud.

18. The machine of claim 16 wherein the at least one retainer is formed separately from the shroud and connected to the shroud.

19. The machine of any one of claims 13 to 18 wherein the shroud does not contact the engine or the operating member when mounted to the frame.

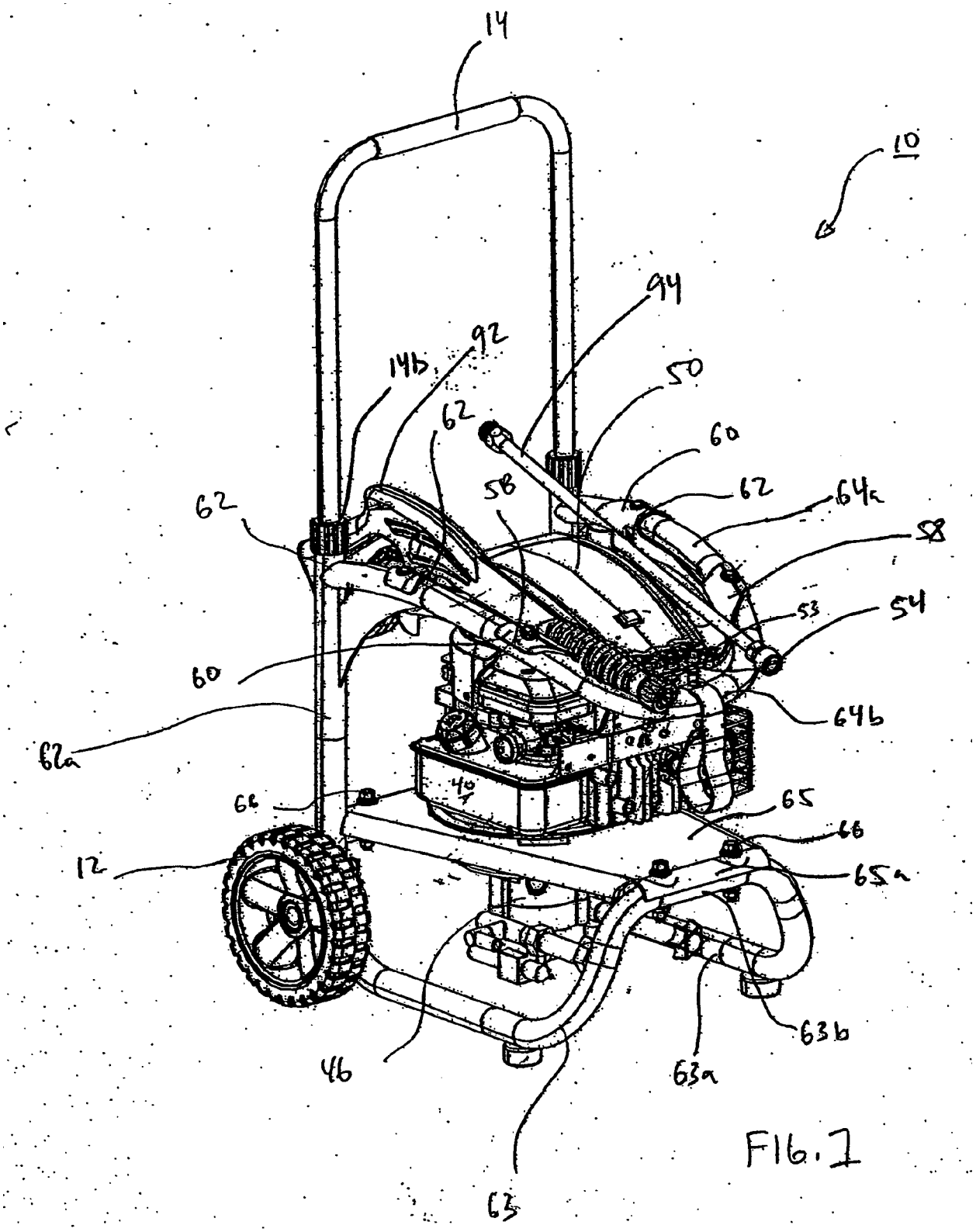
20. The machine of any of claims 13 to 19 wherein the machine is a generator.

21. The machine of any one of claims 13 to 20 wherein the machine is an air compressor.

22. A pressure washer comprising:

(a) an engine that is operatively connected to a pump;
(b) a frame that supports each of the engine and the pump; and
(c) a shroud mounted to the frame independently of the engine and the pump with structure to limit the vibrations produced in the engine or the pump, wherein the shroud at least partially encloses the engine and includes at least one retainer to accept and retain a tool for use with the pressure washer.

23. The pressure washer of claim 22 wherein the shroud is mounted to the frame at a plurality of locations.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64a
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62
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63a
63

FIG. 7

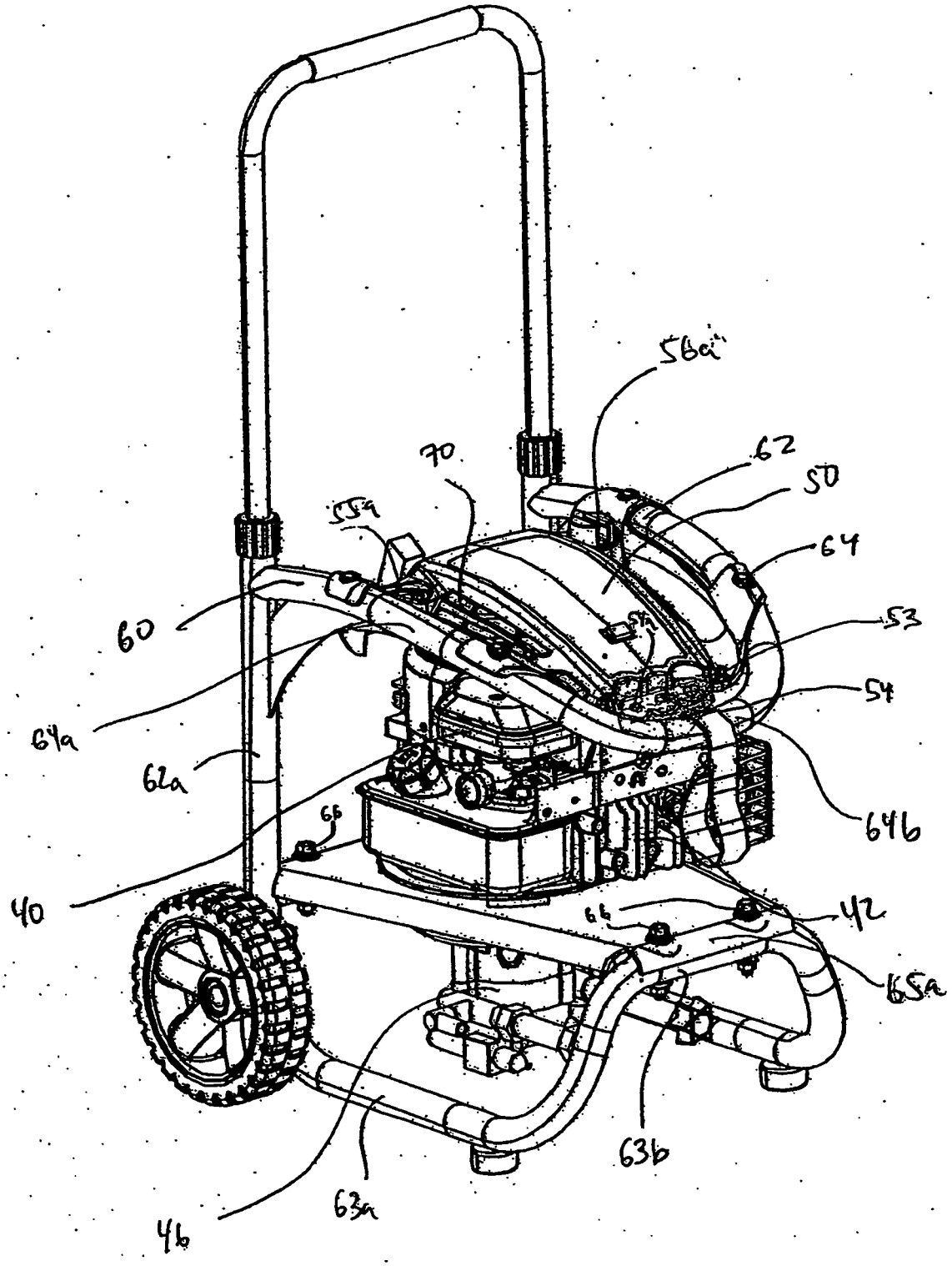

FIG. 2

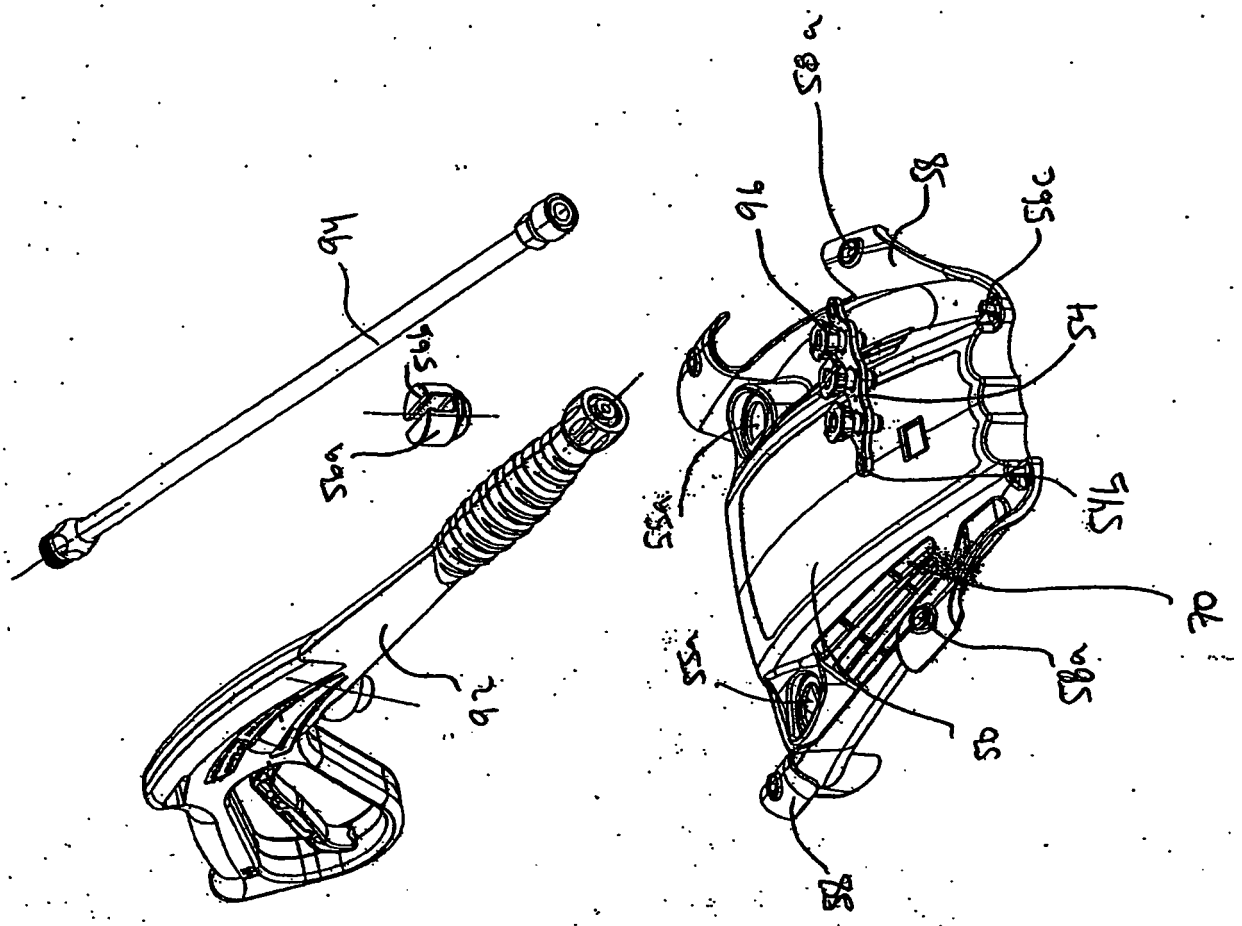

FIG. 3

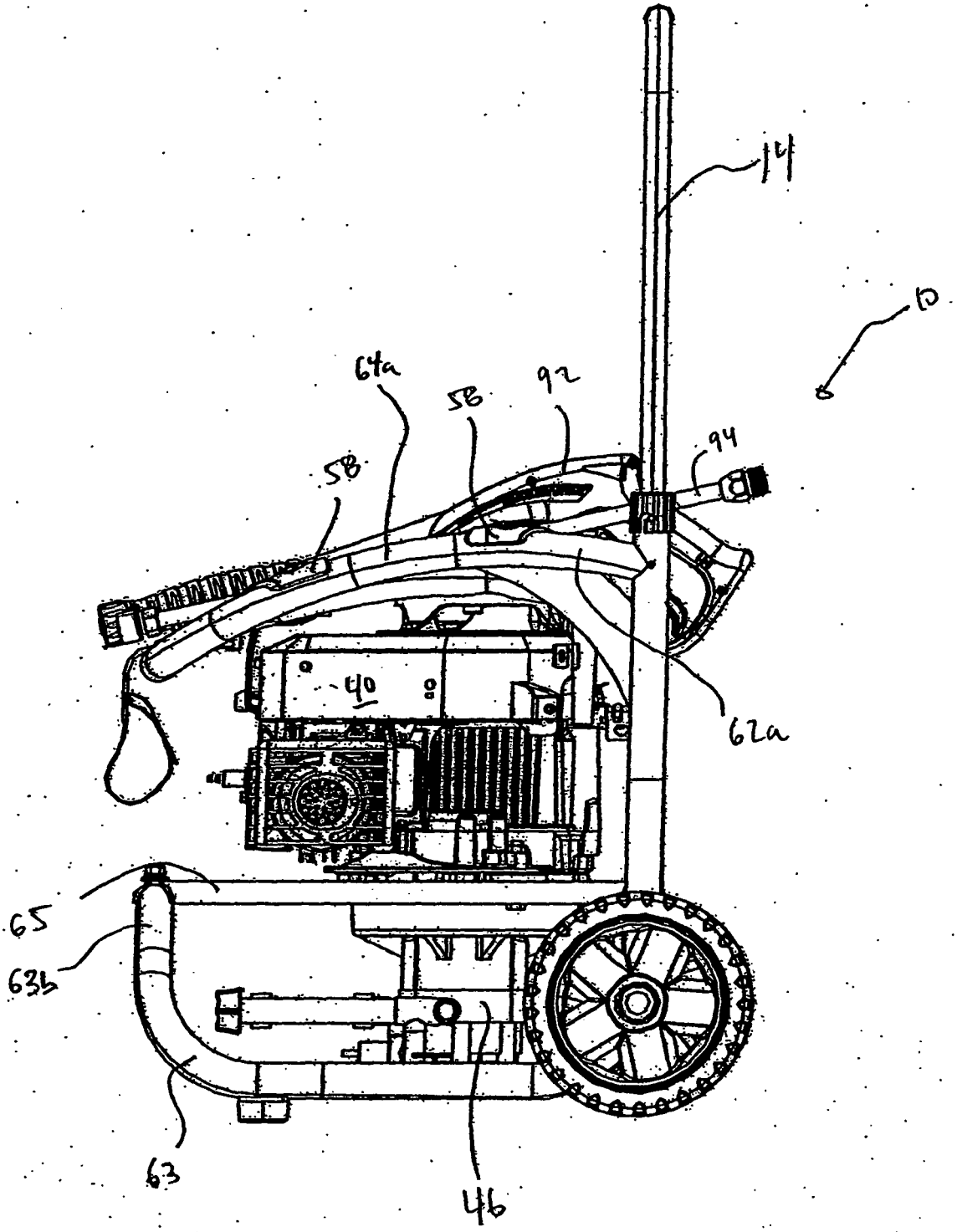

FIG. 4

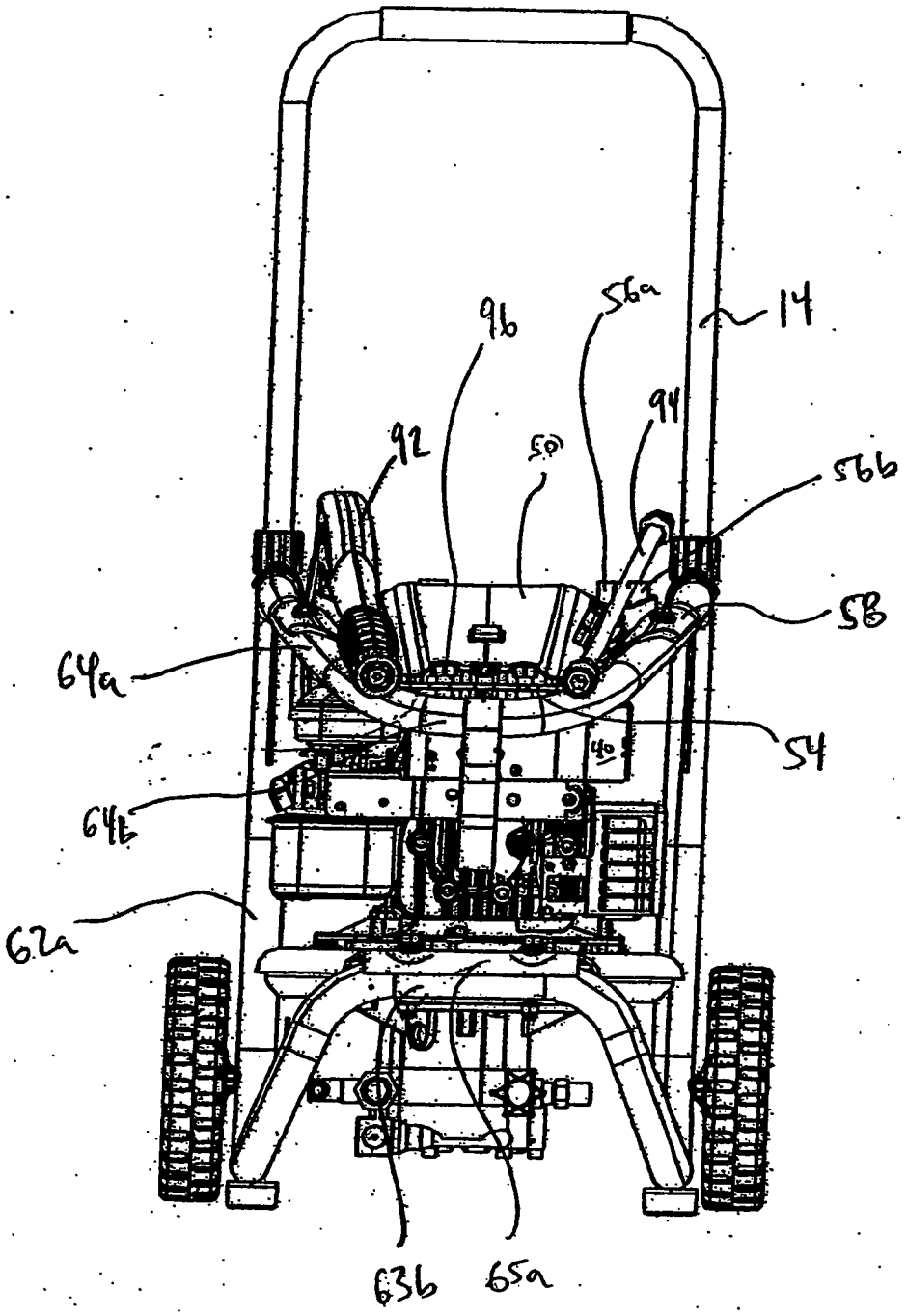

FIG. 5

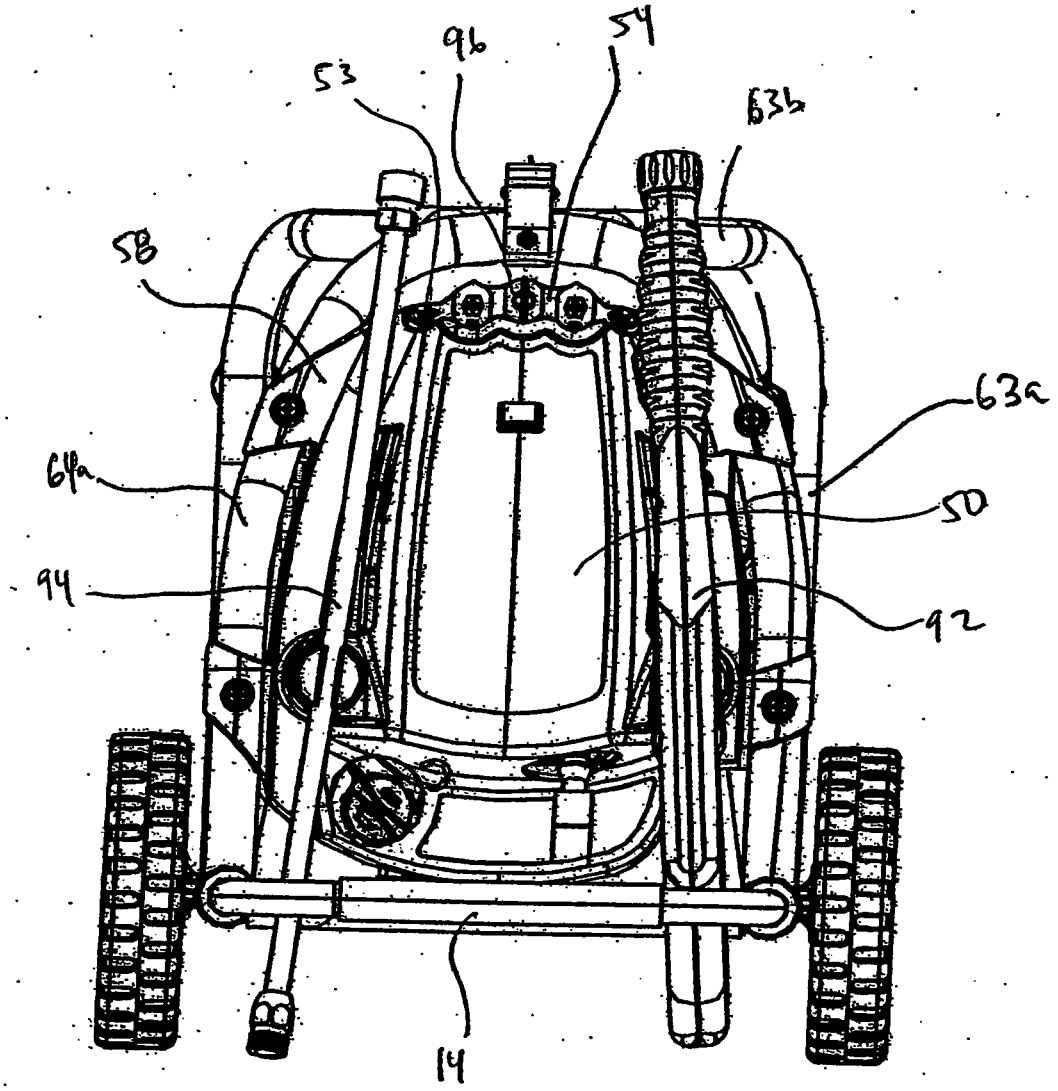

Fig. 6

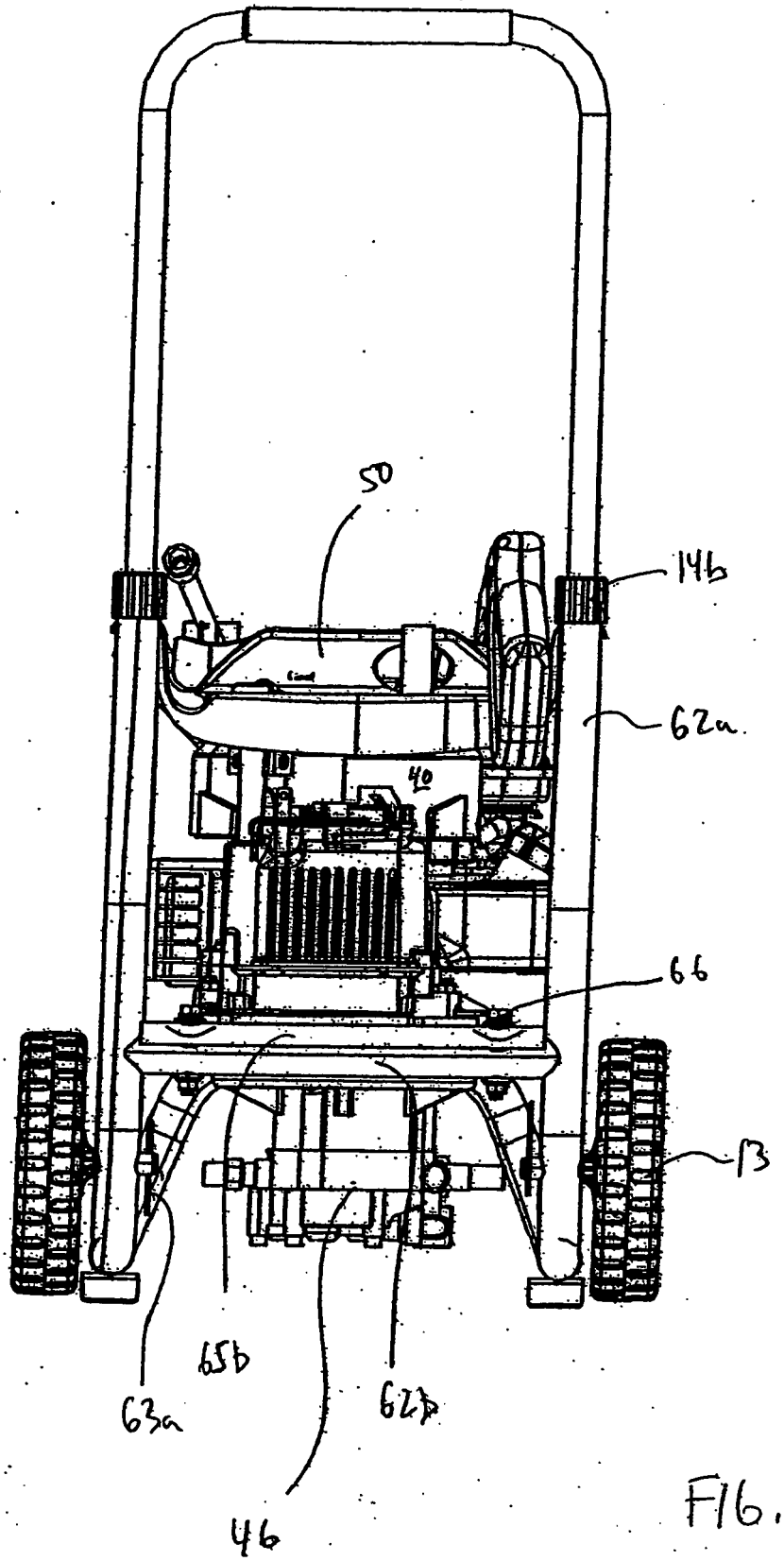

FIG. 7

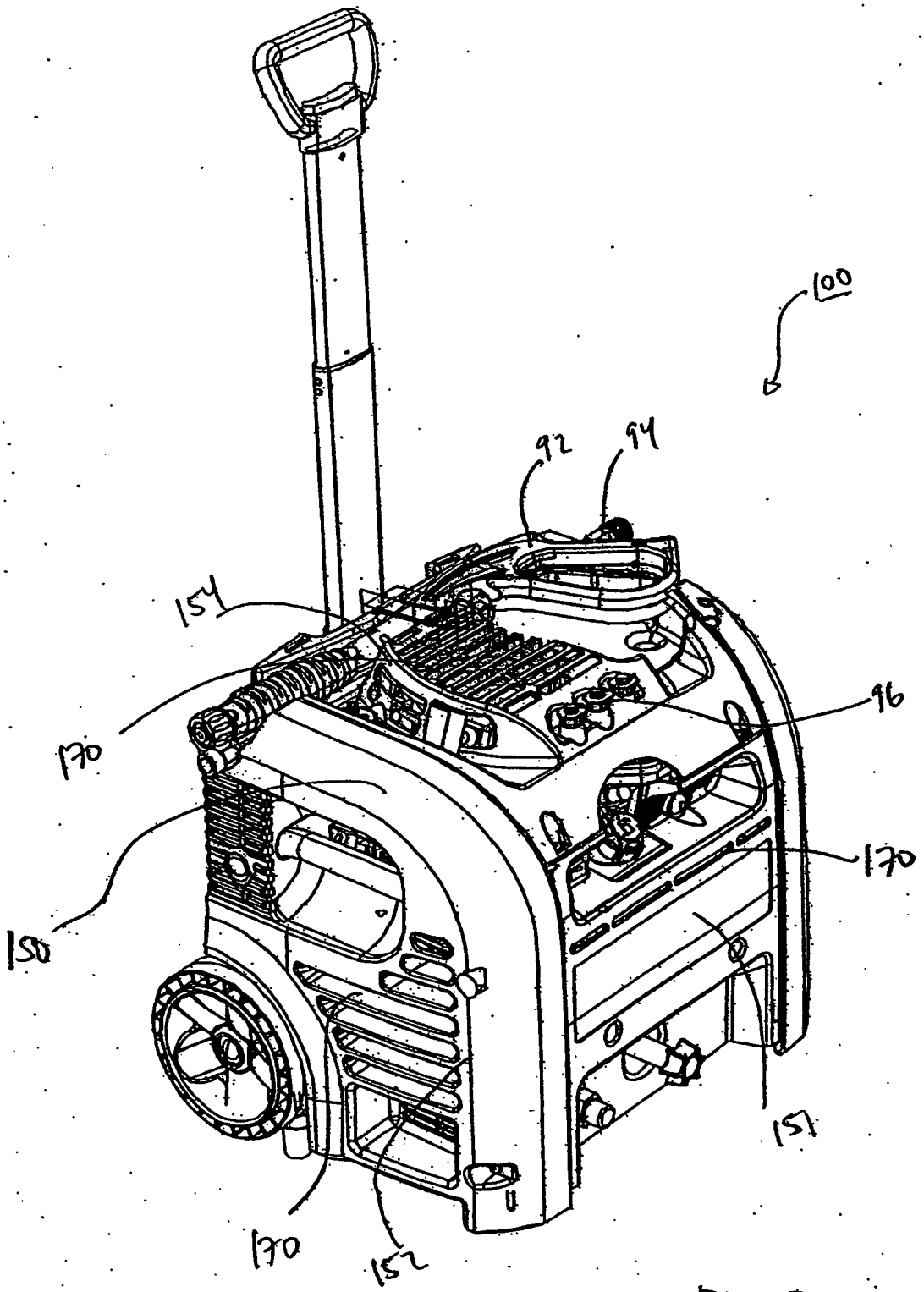

FIG. 8

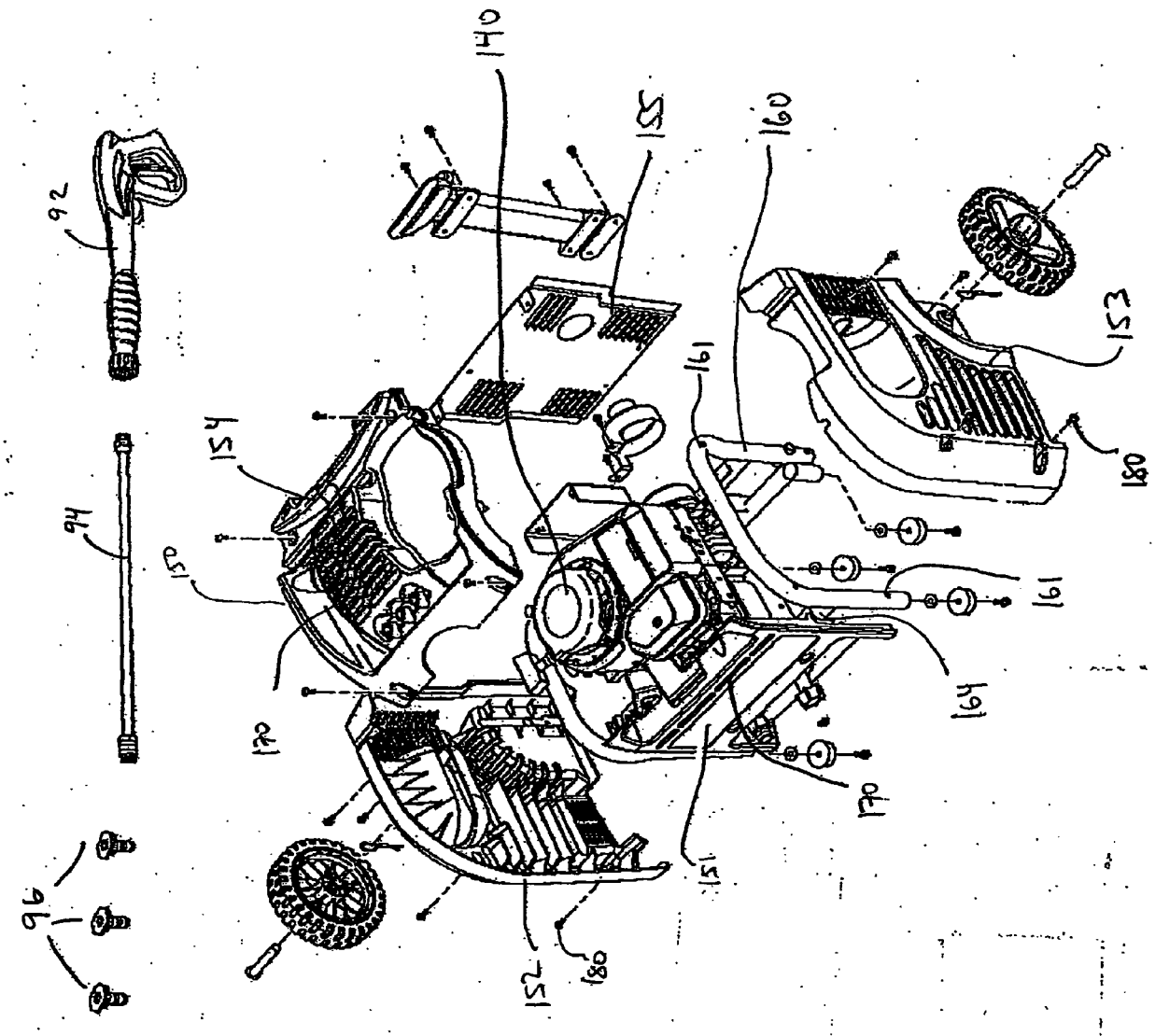

FIG. 9