United States Patent [19]

Schmitz

[11] **3,854,164**

[45] **Dec. 17, 1974**

[54] **SELF-PROPELLED UPRIGHT VACUUM CLEANER**

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[73] Assignee: **Whirlpool Corporation,** Benton Harbor, Mich.

[22] Filed: **Jan. 15, 1973**

[21] Appl. No.: **323,779**

[52] **U.S. Cl.** **15/340,** 15/377, 15/413

[51] **Int. Cl.** **A47l 9/00**

[58] **Field of Search** ..... 15/319, 340, 413, 49 R, 15/49 C, 50 R, 50 C, 377; 180/60, 62, 65 R, 65 F; 318/257

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Primary Examiner—Harvey C. Hornsby
Assistant Examiner—C. K. Moore
Attorney, Agent, or Firm—Hofgren, Wegner, Allen, Stellman & McCord

[57] **ABSTRACT**

A vacuum cleaner structure having self-propelling means. A handle is associated with the vacuum cleaner and the self-propelling means to drive the vacuum cleaner in accordance with force applied forwardly or rearwardly to the handle. The handle is biased to an Off position. The driving force developed by the propelling means varies as a function of the displacement of the handle from the Off position. The propelling means includes wheels carried on the oppositely projecting shaft ends of the drive motor for direct drive by the drive motor.

16 Claims, 24 Drawing Figures

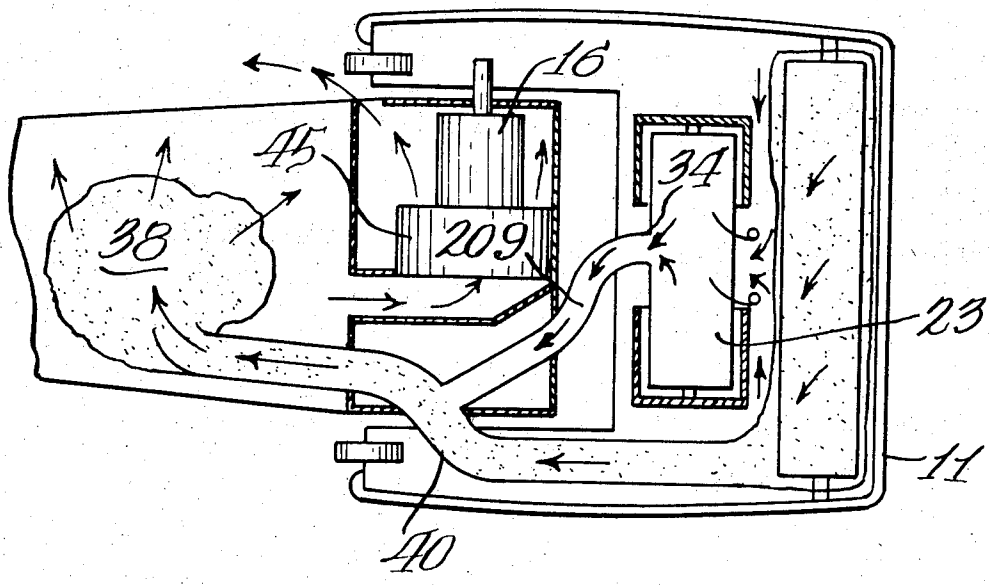


Fig. 1.

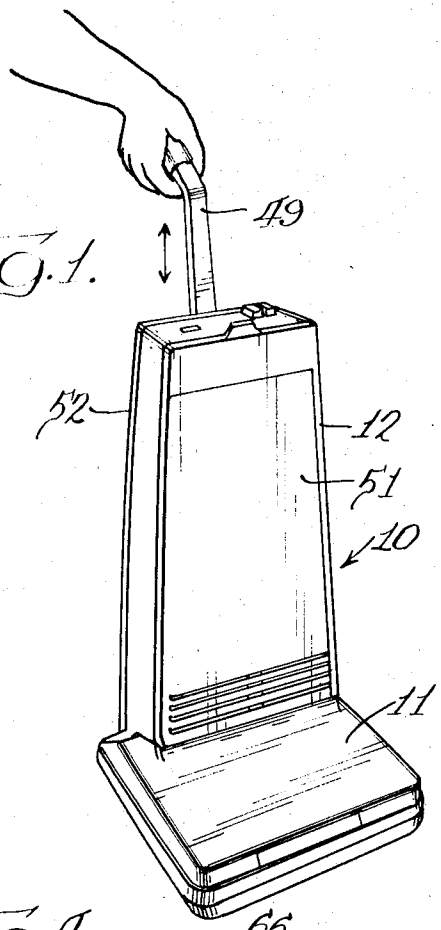


Fig. 3.

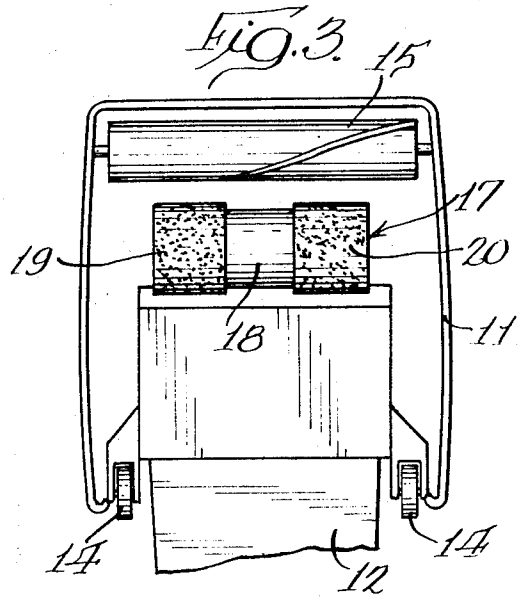


Fig. 2.

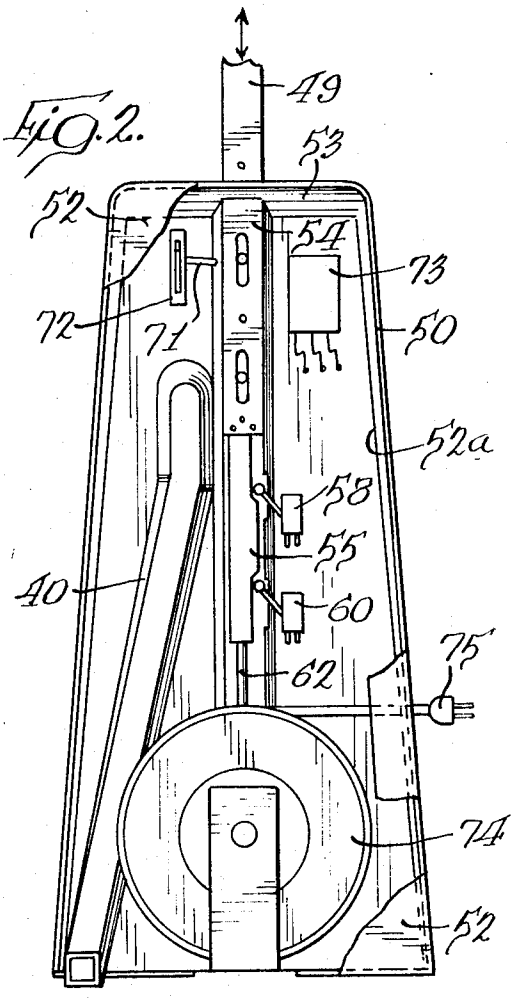


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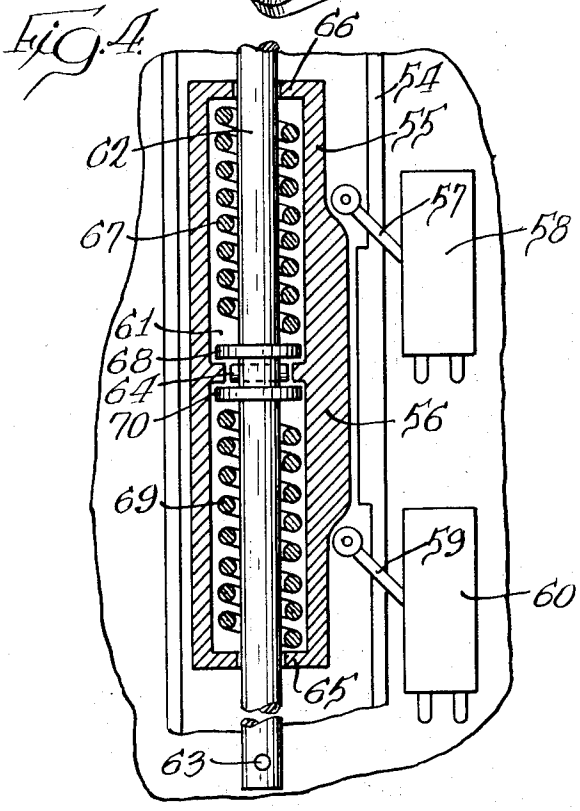


Fig. 5.

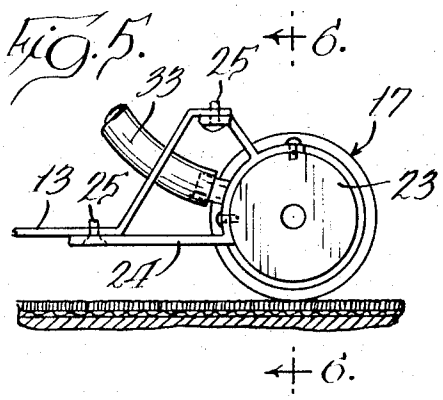


Fig. 6.

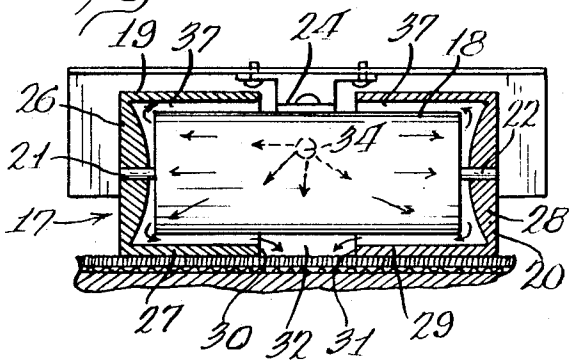


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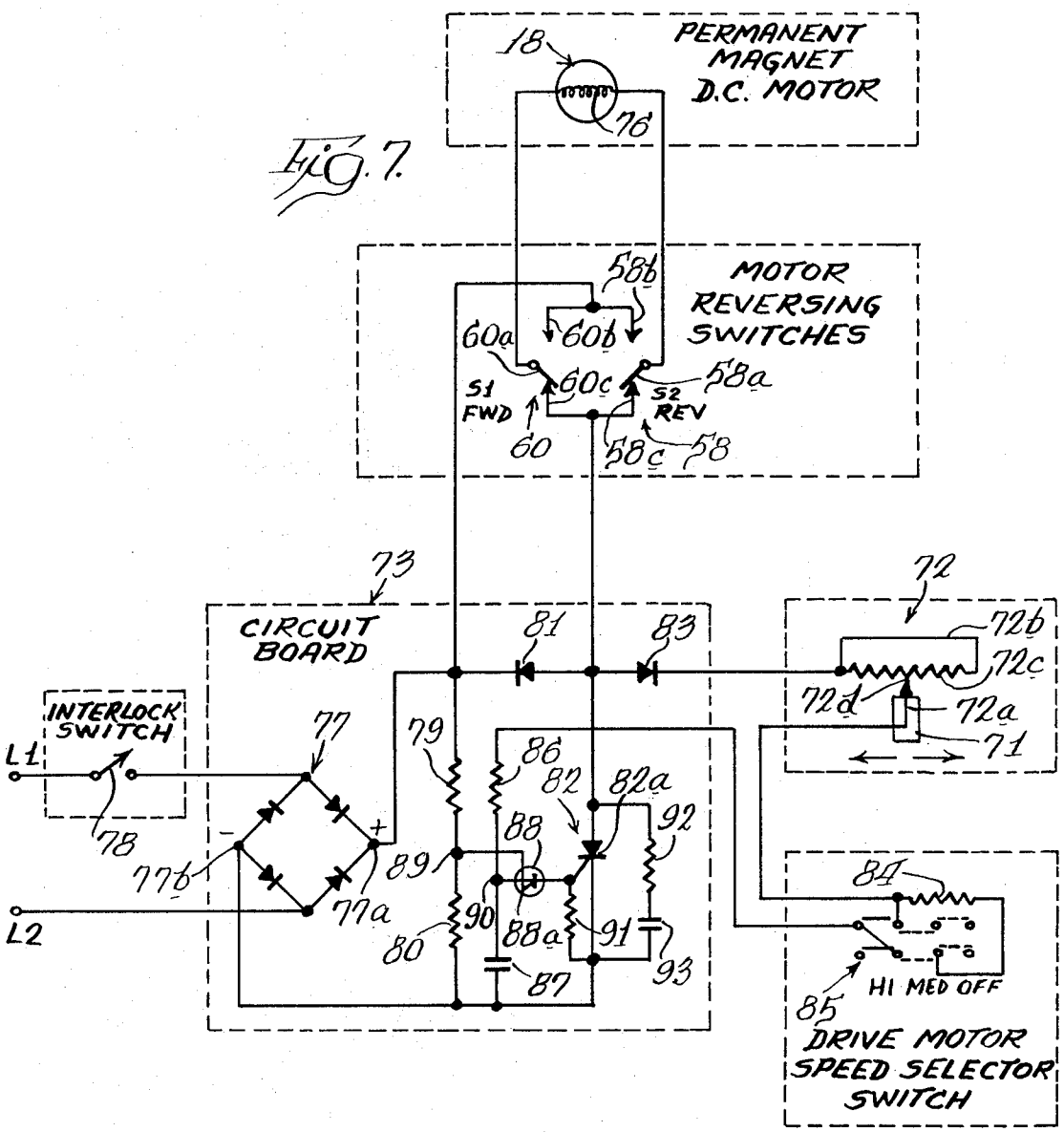
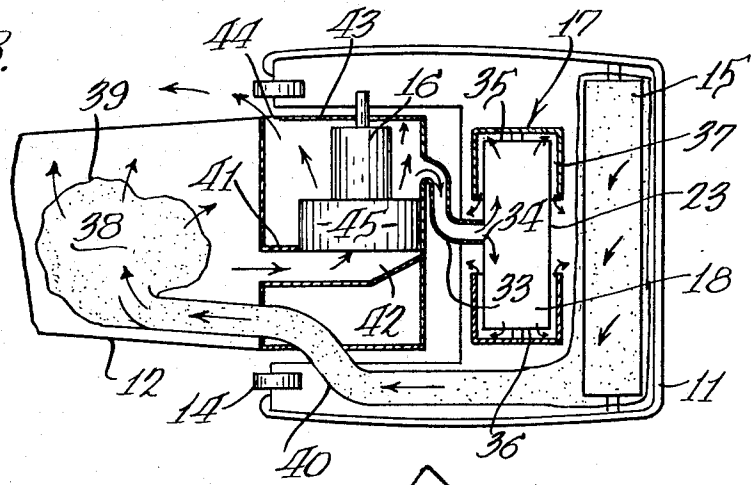


Fig. 8.



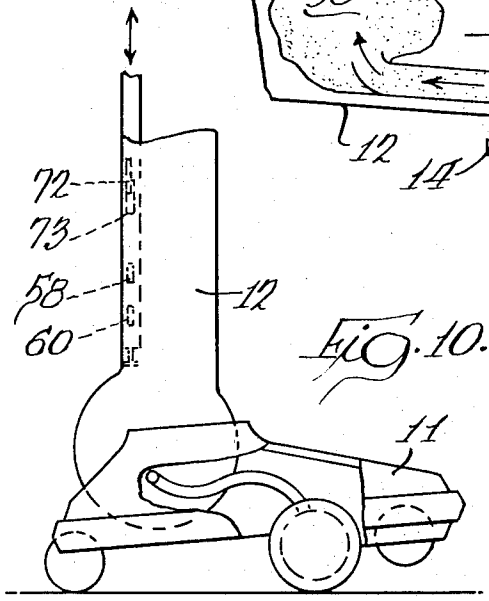


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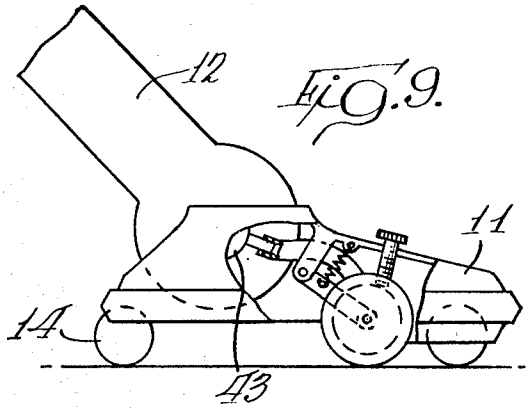
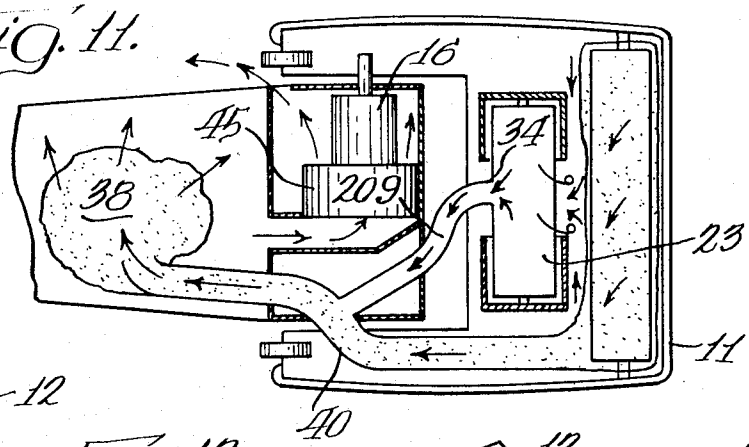


Fig. 9.

Fig. 11.



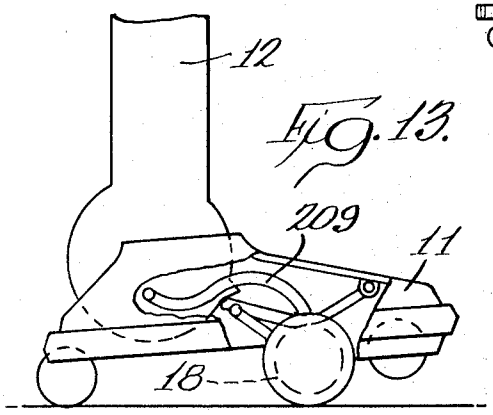


Fig. 13.

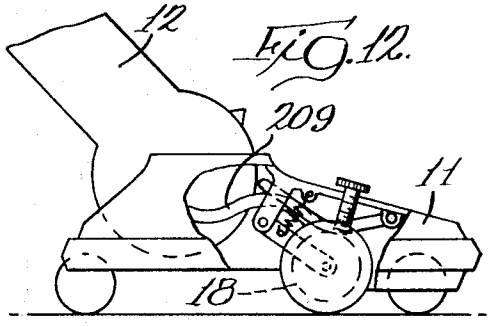


Fig. 12.

Fig. 14.

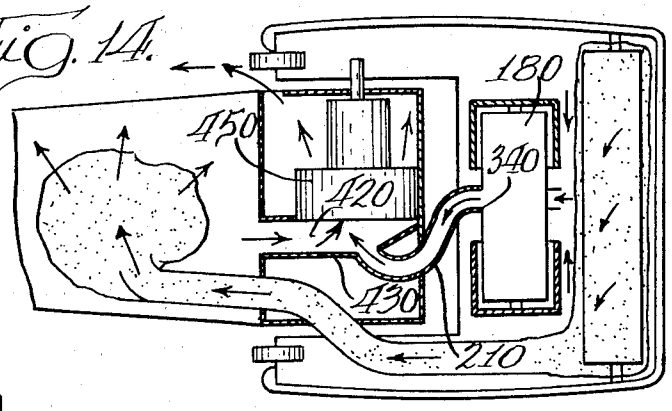


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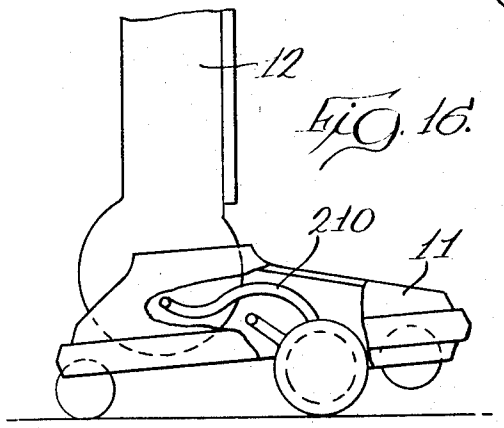


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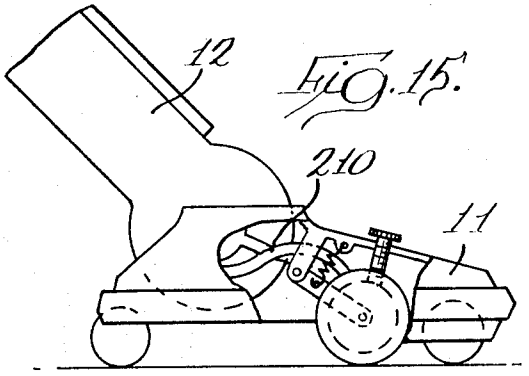


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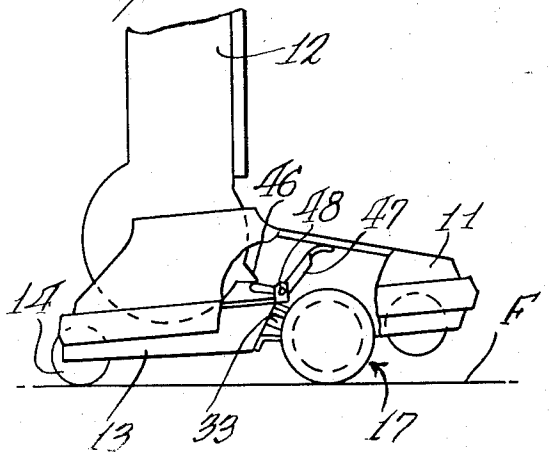


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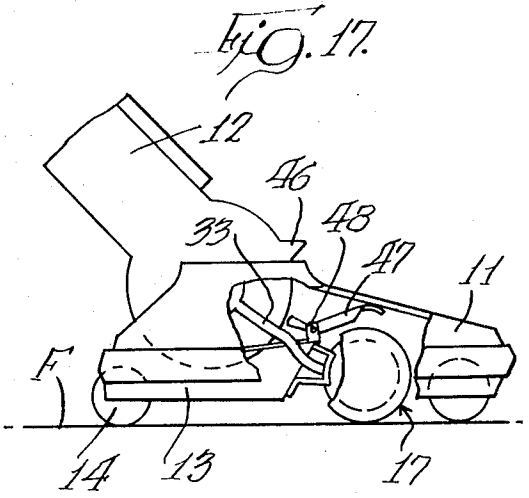


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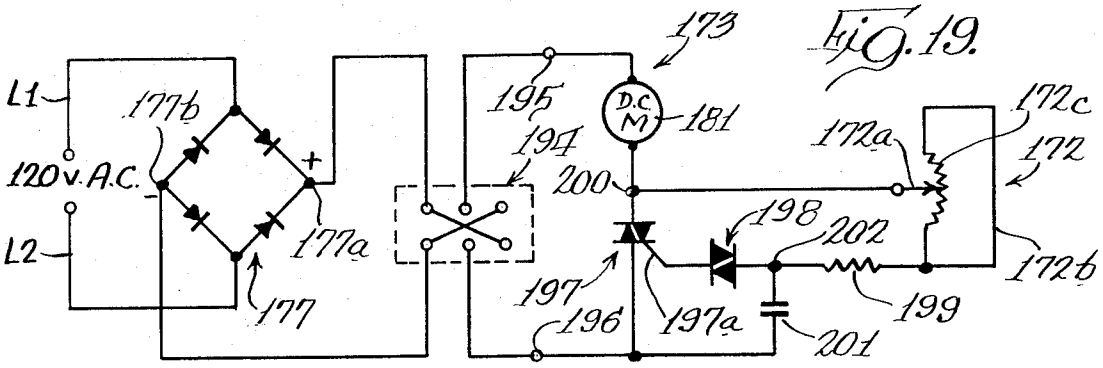


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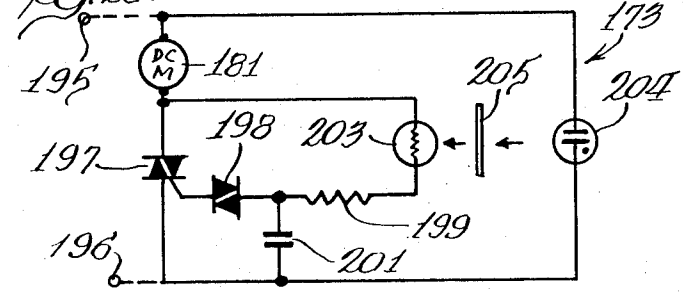
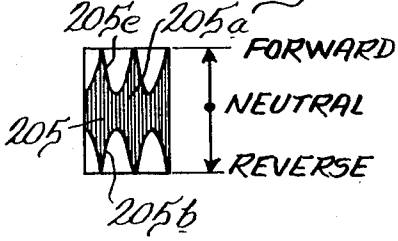


Fig. 21.



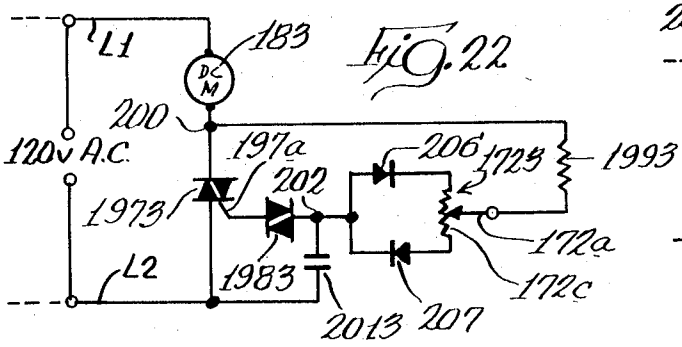


Fig. 22.

Fig. 23.

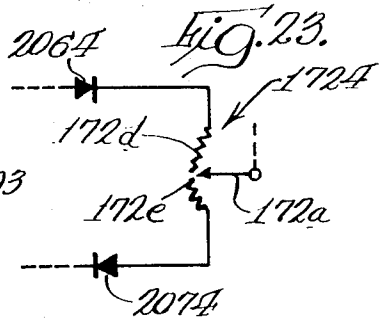
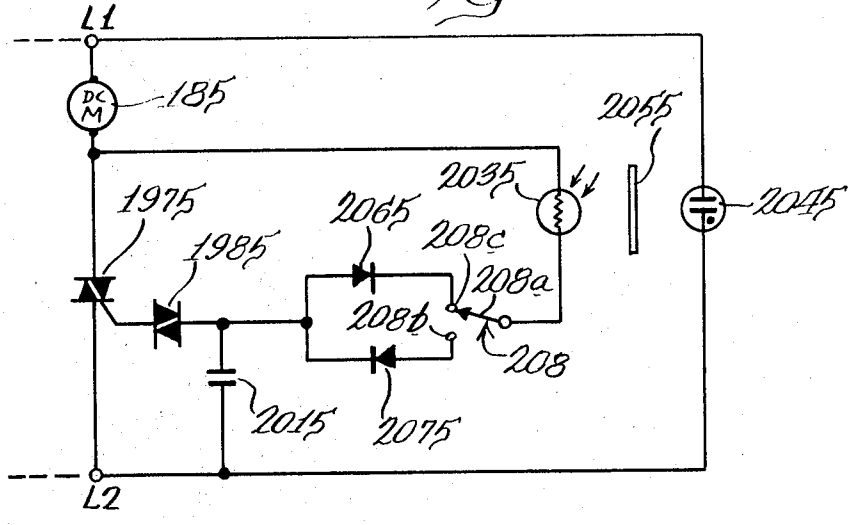


Fig. 24.



SELF-PROPELLED UPRIGHT VACUUM CLEANER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to vacuum cleaners and the like, and in particular to means for propelling vacuum cleaners and the like.

2. Description of the Prior Art

United States Letters Patent which would appear to be pertinent to the present invention are as follows U.S. Pat. Nos.:

716,065	Ledwinka	Automobile
1,076,652	Hoffman	Driving Mechanism for Vehicles
1,098,849	Smart et al	Switch
1,242,115	Russell	Switch for Dental Instruments
1,723,371	Pieper	Combined Tool Handle and Switch
1,813,856	Klein	Direct Drive for Antifriction Roller Bearing Free Wheels
1,953,340	Doemling	Suction Cleaner
2,041,442	Stinsman	Floor Polishing Machine
2,138,239	Irgens	Self-Propelled Implement
2,348,053	Bowker	Electrically Operated Motor Vehicles
2,706,008	Voigt	Powered Golf Bag Carrier
2,823,411	Kirby	Vacuum Cleaner
2,879,858	Thomas	Battery Energized, Motor-Driven Vehicle
2,937,706	Chandler	Self-Propelled Carts
3,095,534	Cockrell	Circuit for Controlling Energization of a Direct Current Load
3,195,029	Gilbreath	Series Motor Control
3,222,582	Heyman et al	Variable Speed Motor System Utilizing Controlled Rectifiers
3,225,853	Norton et al	Control Handle for Golf Cart
3,354,496	Jonsson	Suction Cleaner Nozzle of the Agitator Type
3,385,077	Marsteller	Air Conditioner
3,457,676	Hutson	Photosensitive Power Control System
3,489,874	Baumann	Control Switch for an Electric Dry Razor

Ledwinka U.S. Pat. No. 716,065 shows an automobile construction utilizing an early propelling means.

Hoffman U.S. Pat. No. 1,076,652 shows another form of early drive mechanism for propelling a vehicle.

Smart et al. U.S. Pat. No. 1,098,849 shows a switch adapted to be operated by the longitudinal movement of an actuating member.

Russell U.S. Pat. No. 1,242,115 shows a longitudinal movable switch for use in a dental instrument. Pieper U.S. Pat. No. 1,723,371 shows a similar switch.

Klein U.S. Pat. No. 1,813,856 shows a drive having an electric motor for each of a plurality of wheels.

Doemling U.S. Pat. No. 1,953,340 shows a vacuum cleaner wherein an agitator is driven from an actuating motor separate from the fan motor.

Stinsman U.S. Pat. No. 2,041,442 shows a floor polishing machine having a fan for ventilating the motor elements.

Irgens U.S. Pat. No. 2,138,239 shows a self-propelled powered lawnmower having a handle grip for controlling forward and rearward movement of the lawnmower.

Bowker U.S. Pat. No. 2,348,053 shows a battery operated motor vehicle having a dynamotor within each wheel.

Voigt U.S. Pat. No. 2,706,008 shows a powered golf bag carrier having a worm gear arrangement providing increased power under heavy loading conditions and braking means to secure the carrier in a stationary position.

Kirby U.S. Pat. No. 2,823,411 shows a vacuum cleaner with the fan motor also driving a brush in the nozzle.

Thomas U.S. Pat. No. 2,879,858 shows a battery driven vehicle wherein the current supplied to the drive motor is varied in accordance with the tension applied to the handle thereof.

Chandler U.S. Pat. No. 2,937,706 shows a self-propelled cart having a handle controlling the electric drive motor thereof with the amount of pull on the handle varying the force developed by the motor.

Cockrell U.S. Pat. No. 3,095,534 shows a circuit for controlling energization of a direct current load utilizing a controlled rectifier in controlling the current to the motor armature. Gilbreath U.S. Pat. No. 3,195,029 shows a series motor control using a controlled rectifier in similarly controlling the current to the motor armature. Heyman et al. U.S. Pat. No. 3,222,582 shows a motor system utilizing controlled rectifiers.

Norton et al. U.S. Pat. No. 3,225,853 show a control handle for a golf cart providing adjustable power as a function of the magnitude of the applied force.

Jonsson U.S. Pat. No. 3,354,496 shows a vacuum cleaner nozzle having an agitator driven by an electric motor.

Marsteller U.S. Pat. No. 3,385,077 shows an air conditioner wherein modulation of the air flow is controlled by an optical system utilizing a photocell. Hutson U.S. Pat. No. 3,475,676 shows a photosensitive power control system utilizing similar optical means.

Baumann U.S. Pat. No. 3,489,874 shows a control switch for an electric razor having an operating knob which is selectively slidable, pivotable, or rockable in the casing.

Thus, the prior art shows the concept of propelling means such as automobiles, lawnmowers, golf bag carriers, and golf carts by self-contained motor driven power means. The art further shows the use of push-pull, longitudinally movable controls such as in electric switches, dental instruments, lawnmowers, and golf carts.

The prior art further shows the use of vacuum cleaners having motor driven suction fans and motor driven agitators. Still further, it is known to use direct current motors for reverse driving of devices and to use controlled rectifier means for controlling the current flow

to such a motor for varying the speed and torque thereof.

SUMMARY OF THE INVENTION

The present invention comprehends an improved vacuum cleaner construction having new and improved means for effecting controlled self-propelling thereof. Further, the present invention comprehends the use of the air moving means of the vacuum cleaner in conjunction with the propelling means for an improved efficiency thereof. The movement of the vacuum cleaner is effected by application of force to the handle thereof for controlling the drive motor through a new and improved control means.

More specifically, the control effects rectification of an alternating current power supply to permit use of a direct current motor as the propelling drive means.

The propelling drive means includes wheels carried on the oppositely projecting shaft ends of the drive motor. The wheels may define means for deflecting cooling air against the motor. The wheeled drive may be mounted to the carriage of the vacuum cleaner or to the nozzle in different embodiments of the invention. The cooling air may be drawn through the motor by the vacuum cleaner suction fan or may be delivered to the motor under pressure from the suction fan in different embodiments of the invention. The cooling air may comprise air from which dirt has been removed by the vacuum cleaner. Alternatively, the cooling air may comprise atmospheric air drawn by the suction fan concurrently with the drawing of the dirt laden air to the dirt separating means. The cooling air may be passed through the interior of the motor housing through suitable openings therein and may also be directed against the exterior of the housing by deflecting means such as the drive wheels as discussed above.

The drive wheels may comprise cup-shaped elements partially surrounding the motor housing while leaving a passage therebetween intermediate the ends of the motor housing for passing cooling air therethrough.

The means for controlling the operation of the propelling motor may include an electronic switch phase controlled to vary the current to the motor as a function of the position of the handle means. The control may function to provide power during each half cycle of the alternating current power supply. Alternatively, the control may function to provide current only during similar polarity half cycles of the alternating current power supply to slectively reversely operate the motor as a function of the selected polarity.

The phase controlled electronic switch may comprise a controlled rectifier. In one form, the rectifier comprises a bidirectional triode thyristor. In another embodiment, the rectifier comprises a silicon controlled rectifier. In one embodiment, the means for controlling the control gate of the controlled rectifier comprises a bidirectional trigger diode. In another embodiment, the means for controlling the control gate comprises a silicon unilateral switch.

Phase control of the controlled rectifier may be provided by varying a resistance in the control circuit thereof. In one embodiment, the variable resistance comprises a potentiometer. The potentiometer may have a gap in the mid-portion of the resistor thereof to provide an Off condition. In another embodiment, the variable resistor comprises a photocell and means for varying the amount of light striking the photocell from a light source for providing a low cost, long life adjustable resistance means. The means for varying the transmitted light may comprise a suitable mask positioned by the handle of the vacuum cleaner.

In another embodiment of control wherein the motor is operated only on similar polarity half cycles of the alternating current power supply, the variable resistance is connected to the means for triggering the controlled rectifier through a parallel inverse diode circuit. Selection of the polarity of the motor operating current may be obtained by connecting a potentiometer resistor across the parallel circuit with the slider of the potentiometer connected to the motor. Alternatively, selection of the polarity may be effected by a selector switch having the moving contact selectively engageable with fixed contacts connected one each to the different inversely connected diodes.

More specifically, the present invention comprehends the provision in vacuum cleaner having means for removing dirt from dirt laden air and discharging the cleared air to atmosphere including an assembly of a carriage, an air conducting nozzle on the carriage, dirt collecting chamber means, powered air moving means for moving air through said nozzle to said dirt collecting chamber means for removing the dirt therefrom, and an upstanding handle connected to the assembly for moving the assembly selectively forwardly and rearwardly over a surface to be vacuum cleaned of propelling means comprising drive wheel means mounted to the assembly for engaging the surface to be cleaned, motor means carried by the assembly for reversibly driving the wheel means, and control means for operating the motor means in a forward driving direction when the handle is urged forwardly, and operating the motor means in a rearward driving direction when the handle is urged rearwardly, the control means permitting operation of the motor means concurrently with the operation of the air moving means and precluding driving operation of the motor means when the handle is disposed in a preselected Off position.

Further more specifically, the vacuum cleaner structure of the present invention includes passage means for conducting cooling air into and from the housing, and means for connecting the air moving means to the passage means for effecting forced ventilation cooling of the motor concurrently with the suction of dirt laden air through the nozzle.

Further more specifically, alternatively, the invention comprehends the provision in a vacuum cleaner structure including a carriage and suction nozzle carried by the carriage of propelling means comprising a pair of drive wheels, a drive motor having axial, oppositely outwardly extending shaft extensions, the wheels being fixed one each to the shaft extension to define with the motor a wheeled drive, and means for pivotally mounting the wheeled drive to the nozzle or fixedly to the carriage.

BRIEF DESCRIPTION OF THE DRAWING

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawing wherein:

FIG. 1 is a perspective view of a vacuum cleaner embodying the invention;

FIG. 2 is a fragmentary rear elevation thereof with the rear cover of the bag enclosure partially removed to illustrate details of the drive control;

FIG. 3 is a fragmentary bottom plan view thereof;

FIG. 4 is a fragmentary enlarged vertical section illustrating the handle switch control means;

FIG. 5 is a fragmentary vertical section illustrating the propelling means mounted to the carriage of the vacuum cleaner.

FIG. 6 is a diametric section taken substantially along the line 6—6 of FIG. 5;

FIG. 7 is a schematic wiring diagram of the electric drive control;

FIG. 8 is a fragmentary plan view with portions broken away illustrating one embodiment of the invention wherein cooling air is delivered from the suction fan to the drive motor;

FIG. 9 is a fragmentary side elevation thereof;

FIG. 10 is a fragmentary side elevation thereof with the nozzle in a raised position;

FIG. 11 is a plan view illustrating another embodiment of the invention wherein cooling air is sucked through the drive motor to pass with dirt laden air to the dirt separating means;

FIG. 12 is a fragmentary side elevation thereof;

FIG. 13 is a fragmentary side elevation thereof with the nozzle in a raised position;

FIG. 14 is a plan view illustrating another embodiment of the invention wherein cooling air is drawn through the drive motor to the suction inlet of the fan;

FIG. 15 is a fragmentary side elevation thereof;

FIG. 16 is a fragmentary side elevation thereof with the nozzle in a raised position;

FIG. 17 is a fragmentary side elevation of the vacuum cleaner construction of FIG. 5;

FIG. 18 is a fragmentary side elevation thereof with the nozzle in a raised position;

FIG. 19 is a schematic wiring diagram of a modified form of electrical control of the drive means;

FIG. 20 is a schematic wiring diagram illustrating a still further modified control;

FIG. 21 is an elevation of a mask for use in the control of FIGS. 20 and 24;

FIG. 22 is a schematic wiring diagram of yet another modified form of control;

FIG. 23 is a fragmentary schematic wiring diagram illustrating a modification of the control of FIG. 22; and

FIG. 24 is a schematic wiring diagram of yet another drive control embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the exemplary embodiments of the invention as disclosed in the drawing, a vacuum cleaner generally designated **10** is shown to comprise an upright vacuum cleaner having a nozzle **11** and an upstanding bag enclosure **12.** The nozzle is mounted to a carriage **13** herein provided with rear wheels **14.** A brush and beater bar **15** is mounted at the front of the nozzle to be driven from the suction fan motor **16** by suitable means (not shown). Herein the vacuum cleaner is driven by a propelling means generally designated **17** comprising a drive motor **18** and a pair of drive wheels **19** and **20** secured to the oppositely projecting shaft ends **21** and **22** of the drive motor. This provides a direct drive relationship between the drive motor and the drive wheels. As shown in FIGS. **5** and **6,** the housing **23** of the drive motor may be secured to the carriage **13** by a suitable bracket **24** and screws **25.**

Wheels **19** and **20** define cup-shaped elements facing toward each other coaxially of the motor as illustrated in FIG. **6.** Thus, wheel **19** defines an end wall **26** and a cylindrical side wall **27,** and wheel **20** defines an end wall **28** and a cylindrical side wall **29.** The distal end **30** of wheel side wall **27** is spaced longitudinally from the distal end **31** of side wall **29** to define a space **32** therebetween for passing cooling air.

As illustrated in FIGS. **5, 6, 8, 17** and **18,** cooling air may be delivered from the suction fan **45** through a duct **33** to the interior of motor housing **23** through an inlet opening **34** in the housing. After passing through the housing, the cooling air may exhaust through the opposite ends **35** and **36** of the housing. As shown in FIGS. **6** and **8,** the cupshaped wheels are spaced axially and circumferentially from the housing to define flow paths **37** whereby the air deflected by the wheels is delivered to the space **32** to exhaust to the atmosphere. As shown in FIG. **8,** the dirt laden air is conducted to bag **39** by means of a duct **40** extending from the nozzle **11** into the enclosure **12** wherein the bag is received. A duct **41** connects the enclosure **12** to the suction inlet **42** of the fan **45.** The shroud **43** extending about the fan motor **16** is provided with a discharge opening **44** for discharging air from the fan **45** to atmosphere. As shown in FIG. **8,** the duct **33** opens through the shroud **43** for receiving a portion of the air delivered from fan **45** for delivery to the drive motor.

As shown in FIG. **17** and **18,** the nozzle **11** may be pivoted on the carriage **13** by means of a projection **46** on housing **12** engaging a lever **47** pivotally mounted on a bracket **48** carried by the carriage **13.** Thus, the wheel drive **17** is maintained in engagement with the subjacent floor F while the nozzle may be pivoted to space the brush and beater bar above the floor level by suitable pivoting of the enclosure **12** on the carriage. Duct **33** maintains the connection between the suction fan and motor **18** in the different relationships of the nozzle and carriage, as illustrated in FIGS. **17** and **18.**

Vacuum cleaner **10** is propelled on the subjacent floor by suitable energization of drive motor **18** as a result of pressure applied to a handle **49** upstanding from the bag housing **12,** as illustrated in FIG. **1.** As shown in FIG. **2,** bag enclosure **12** includes a rear portion **50.** Removal of rear closure **52** of housing **12** provides access to the space **52a** within the rear portion **50.** Handle **49** extends through the top wall **53** of the housing portion **50** and is provided with a slide tube **54** internally carrying a housing **55** defining a cam **56** selectively engageable with the actuator **57** of a first switch **58** and the actuator **59** of a second switch **60.** The switches are carried on the rear housing portion **50.** A centering device generally designated **61** is mounted in housing **55** for centering the cam **56** between the actuators **57** and **59,** as shown in FIG. **4.**

More specifically, the centering device includes a rod **62** fixedly secured to the housing portion **50** by a pin **63.** Rod **62** is provided with a pin **64** intermediate the ends **65** and **66** of housing **55.** A first coil spring **67** extends coaxially about rod **62** to a washer **68** slidably mounted on the rod adjacent pin **64.** A second coil spring **69** extends from housing end **65** to a washer **70** slidably mounted on rod **62** oppositely adjacent pin **64.** Slide tube **54** further is provided with a mechanical ac-

tuator **71**, as shown in FIGS. **2** and **7**, for controlling the setting of a potentiometer **72** carried on the housing portion **50**. As further shown in FIG. **2**, a control **73** is mounted on the housing portion **50** adjacent upper wall **53** and a cord reel **74** is mounted to the housing portion **50** at the lower opposite end with a power supply cord **75** extending from reel **74** outwardly through the housing for connecting the vacuum cleaner to a power source such as a conventional wall receptacle (not shown).

Operation of the vacuum cleaner may best be understood by reference to the schematic electrical wiring diagram of FIG. **7**. As shown, drive motor **18** illustratively comprises a permanent magnet direct current motor having an armature **76** connected between the moving contacts **60***a* of switch **60** and contacts **58***a* of switch **58**. Direct current power is delivered to the motor **18** from alternating current power supply leads L1 and L2 connected to a full wave bridge rectifier **77** through a single pole, single throw interlock switch **78**. The positive output terminal **77***a* of the full wave bridge rectifier is connected to fixed contacts **60***b* and **58***b* of switches **60** and **58**, respectively. A resistor **79** and a resistor **80** are connected in series between terminal **77***a* and the negative terminal **77***b* of rectifier **77**. Diode **81** is connected between terminal **77***a* and second fixed contact **60***c* of switch **60** and second fixed contact **58***c* of switch **58** and through a silicon controlled rectifier **82** to negative terminal **77***b*. Diode **81** is further connected through a second inversely related diode **83** to the potentiometer **72**, having its slider **72***a* connected to a fixed resistor **84** and a drive motor speed selector switch **85**. Switch **85**, in turn, is connected through a fixed resistor **86** and a capacitor **87** to power terminal **77***b*. A silicon unilateral switch **88** has its gate **88***a* connected to terminal **89** between resistors **79** and **80**. Switch **88** is connected from a terminal **90** between resistor **86** and capacitor **87** to the gate **82***a* of the silicon controlled rectifier **82**. A resistor **91** is connected from rectifier gate **82***a* to power terminal **77***b* and a series of connection of a resistor **92** and capacitor **93** is connected across the rectifier **82***a*. A jumper **72***b* is connected to the opposite ends of the resistor **72***c* of potentiometer **72**.

As discussed above, longitudinal movement of handle **49** by the application of force thereto by the user's hand, as shown in FIG. **1**, causes a corresponding movement of cam **56**, as shown in FIG. **4**, to actuate either forward switch **60** or reverse switch **58** as a function of the direction of force application of the handle. Further, the amount of longitudinal handle movement effected controls the positioning of the slider **72***a* of potentiometer **72** to control the silicon unilateral switch **88** and thereby control the amount of current passed by the controlled rectifier **82** thereby to control the speed and torque of the motor **18**. As shown in FIG. **7**, when forward switch **60** is closed, i.e., by a downward movement of cam **56** (FIG. **4**), moving contact **60***a* closes with fixed contact **60***b* to provide power from positive power supply terminal **77***a* through motor armature **76**, switch **58** and through the silicon controlled rectifier to negative terminal **77***b*. Phase control of silicon controlled rectifier **82** is effected by the setting of slider **72***a* relative to resistor **72***c* of potentiometer **72** so as to vary the amount of current passed by rectifier **82** depending on the amount of displacement of slider **72***a* from the center position **72***d* of resistor **72***c*.

Reversely, similarly, where the handle is moved rearwardly so as to move cam **56** upwardly to close switch **58**, positive power supply terminal **77***a* is connected through moving contact **58**a of switch **58** to motor armature **76** and through switch **60** and silicon controlled rectifier **82** to the negative power terminal **77***b* causing a reverse operation of the motor **18** under the speed control of potentiometer **72**.

Electrical components of one control found to provide excellent functioning as described above, are as follows:

18	Motor	American Lincoln Permanent Magnet DC
72	Potentiometer	0 to 1 Megohm
79	Resistor	220 Kilohms
80	Resistor	2.2 Kilohms
81	Diode	1N1694
82	Silicon Controlled Rectifier	GE C22B
83	Diode	1N1694
84	Resistor	330 Kilohms
86	Resistor	1 Kilohm
87	Capacitor	0.8 mfd.
88	Silicon Unilateral Switch	GE 2N4987
91	Resistor	100 Ohms
92	Resistor	33 Ohms
93	Capacitor	0.01 mfd.

Modified controls suitable for use in controlling the operation of a motor corresponding to motor **18** are illustrated in FIGS. **19–24**. As shown in FIG. **19**, a control generally designated **173** is shown to include a full wave rectifier **177** connected to the alternating current power supply leads L1 and L2. A selector switch **194** is connected to the output terminals **177***a* and **177***b* of the power supply for selectively connecting power supply terminal **177***a* to a motor terminal **195** or a terminal **196** and power supply terminal **177***b* concurrently to terminal **196** or terminal **195** as a function of the position of the vacuum cleaner handle. The means for controlling current through the motor **18** comprises a controlled rectifier illustratively comprising a bidirectional triode thyristor, or triac, **197** having its gate **197***a* controlled by a bidirectional trigger diode, or diac, **198** connected in series with a fixed resistor **199** and a potentiometer **172** to a terminal **200** connected between motor **18** and triac **197**. Triac **197** is connected between motor **18** and terminal **196** and a capacitor **201** is connected from a terminal **202** between diac **198** and resistor **199** and terminal **196**. The slider **172***a* of potentiometer **172** is connected to terminal **200** and the resistor **172***c* has its opposite ends connected by a jumper **172***b*.

Thus, current flow to motor **18** is controlled by the triac **197** under the phase control of diac **198** which, in turn, is controlled by the setting of potentiometer slider **172***a* and switch **194** by the vacuum cleaner handle to provide selectively reversible operation of the vacuum cleaner wheeled drive motor at different speeds and torques as desired.

As shown in FIG. **20**, the portion of the control **173** connected to terminals **195** and **196** may be modified to utilize a photocell **203** in lieu of potentiometer **172** as a variable resistance for controlling the diac **198**. A neon lamp **204** may be connected between terminals **195** and **196** for directing light to the photocell **203**. A mask **205** carried for movement with the vacuum cleaner handle **49** is interposed between lamp **204** and photocell **203** to control the resistance of the photocell.

As shown in FIG. **21**, the mask **205** includes an opaque portion **205***a* defined by downwardly opening cusps **205***b* and upwardly opening cusps **205***c* for varying the amount of light received by the photocell as a function of the movement of the mask from a centered position under the control of the vacuum cleaner handle. The control of FIG. **20** thus provides an improved long life control as frictional wear of control elements is avoided.

Referring to FIGS. **22–24**, further modified control means for controlling a wheeled drive motor **18** of the vacuum cleaner are shown to provide such control under half wave voltage conditions. More specifically, as shown in FIG. **22**, motor **18** may be connected through a triac **1973** across the alternating current power supply leads L1 and L2. The triac is phase controlled by a diac **198** connected to its gate **197***a*. A capacitor **2013** is connected from power supply lead L2 to terminal **202**. A fixed resistor **1993** is connected from terminal **200** to the slider **172***a* of potentiometer **1723** having its resistor **172***c* connected between parallel inverse diodes **206** and **207** which, in turn, are connected to terminal **202**. Resistor **172***c* preferably has a relatively high value, such as 4 or 5 megohms, and thus prevents triggering of the triac **1973** when in the center position, as shown in FIG. **22**. However, when the vacuum cleaner handle is moved in either direction to correspondingly move the slider **172***a*, the triac is triggered during similar half cycles of the alternating current power supply. Thus, illustratively, when the slider **172***a* is moved upwardly as seen in FIG. **22**, the triac is triggered on positive half cycles and when the slider is moved downwardly, the triac is triggered on negative half cycles. Further, as the total resistance of the circuit through the diode varies as the amount of movement of the slider **172***a*, motor **183** is controlled not only as to direction of movement, but also as to speed and torque by the phase control of triac **1973** by diac **1983**.

As shown in FIG. **23**, the potentiometer may be provided with a modified resistor **172***d* having a gap **172***e* at the center portion so that when the slider **172***a* is in the center position, the control will be in an Off condition as no current can flow to the diac **1983** from terminal **200**.

Referring now to FIG. **24**, a further modified control is shown to comprise a control similar to that illustrated in FIG. **22** but within the variable resistance is provided by photocell **2035** in lieu of the potentiometer **172** and the switching function is provided by a selector switch **208** having its moving contact **208***a* connected in series with the photocell **2035**, one fixed contact **208***b* connected to diode **2075**, and a second fixed contact **208***c* connected to diode **2065**. The resistance of photocell **2035** is controlled by lamp **2045** and mask **2055** as described above relative to the control of FIG. **20**. Switch **208** is operated by handle **49** concurrently with the moving of mask **2055** to provide the desired reverse operation of vacuum cleaner drive motor **185** concurrently with the speed and torque control thereof by the control of the variable resistance of photocell **2035**. The control of FIG. **24** is similar to the control of FIG. **22** in that the operation of the motor **185** is by similar polarity half cycles of the alternating current power supply by means of the inverse parallel diodes **2065** and **2075**.

Illustrative circuit components for the elements of the controls of FIGS. **19–24** are as follows:

172	Potentiometer	0 to 1 Megohm
177	Full Wave Rectifier	200 Volt PRV, 4 Amperes
181	Motor	American Lincoln Permanent Magnet DC
194	Selector Switch	DPDT
197	Triac	GE SC40B
198	Diac	GE ST-2
199	Resistor	30 Kilohms
201	Capacitor	0.1 mfd.
182	Motor	American Lincoln Permanent Magnet DC
1972	Triac	GE SC40B
1982	Diac	GE ST-2
1992	Resistor	30 Kilohms
2012	Capacitor	0.1 mfd.
203	Photocell	Vactec VT-101H
204	Lamp	Signalite Neon
1723	Potentiometer	0 to 1 Megohm
183	Motor	American Lincoln Permanent Magnet DC
1973	Triac	GE SC40B
1983	Diac	GE ST-2
1993	Resistor	30 Kilohms
2013	Capacitor	0.1 mfd.
206	Diode	1N1694
207	Diode	1N1694
1724	Potentiometer	0 to 1 Megohm
2064	Diode	1N1694
2074	Diode	1N1694
185	Motor	American Lincoln Permanent Magnet DC
1975	Triac	GE SC40B
2035	Photocell	Vactec VT-101H
2065	Diode	1N1694
2075	Diode	1N1694
2045	Lamp	Signalite Neon

The modified controls of FIGS. **19–24** function in the vacuum cleaner structure similarly to the control **73** except as otherwise noted above.

Referring now to FIGS. **11–16**, the vacuum cleaner construction may include modified means for effecting the delivery of cooling air to the drive motor **18** by means of the suction fan **45**. Thus, as shown in FIGS. **11–13**, a duct **209** may be connected between the motor housing opening **34** and the suction duct **40** leading from the nozzle **11** to the dirt collecting chamber **38**. Thus the suction pressure effected by fan **45** serving to draw dirt laden air into the vacuum cleaner concurrently serves to draw air through the motor housing **23** to cool the drive motor by sucking the air therethrough to the dirt separating chamber.

Referring now to FIGS. **14–16**, a further modified form of vacuum cleaner construction embodying the invention is shown to include a duct **210** connecting the motor housing opening **340** directly to the suction inlet **420** of the fan **450** defined by the shroud **430**. Thus, the cooling air sucked through the drive motor **180** is delivered directly to fan **450** rather than through the dirt separating chamber as in the embodiment of FIGS. **11–13**. In all other respects, the vacuum cleaner constructions of FIGS. **11–16** are similar to the vacuum cleaner construction illustrated in FIG. **8–10** and similar elements thereof are identified by related reference numerals.

Thus, the vacuum cleaner constructions of the present invention provide an improved facilitated propelling of the vacuum cleaner over the surface to be cleaned. The drive motor of the propelling means and the suction fan of the vacuum cleaner are cooperatively associated for improved efficiency and low cost of the unit. Improved trouble-free, long life control means are provided for effecting desired reversible driving of the propelling means. The vacuum cleaner constructions of the present invention are extremely simple and eco-

nomical of manufacture while yet providing the highly desirable features discussed above.

The foregoing disclosure of specific embodiments is illustrative of the broad inventive concepts comprehended by the invention.

I claim:

1. In a vacuum cleaner having means forming a dirt collecting chamber, a selectively positionable handle attached to said means forming a dirt collecting chamber for controlling movement of the vacuum cleaner selectively forwardly and rearwardly over a surface to be vacuum cleaned, an air conducting nozzle in communication with said dirt collecting chamber, and air moving means including first motor means for moving air through said nozzle to become dirt laden and moving said dirt laden air to said dirt collecting chamber means for removing the dirt therefrom, propelling means comprising: drive wheel means mounted on said vacuum cleaner nozzle for engaging the surface to be cleaned; second motor means carried by said vacuum cleaner nozzle and drivingly connected to said drive wheel means; and means for selectively controlling said second motor means for reversibly driving said drive wheel means forwardly and rearwardly in response to selective positioning of said handle, said air moving means including means for conducting cooling air other than the dirt laden air in heat transfer association with said second motor means for cooling said second motor means.

2. In a vacuum cleaner having means forming a dirt collecting chamber, a selectively positionable handle attached to said means forming a dirt collecting chamber for controlling movement of the vacuum cleaner selectively forwardly and rearwardly over a surface to be vacuum cleaned, an air conducting nozzle in communication with said dirt collecting chamber, and air moving means including first motor means for moving air through said nozzle to said dirt collecting chamber means for removing the dirt therefrom, propelling means comprising: drive wheel means mounted on said vacuum cleaner nozzle for engaging the surface to be cleaned; second motor means carried by said vacuum cleaner nozzle and drivingly connecting to said drive wheel means; and means for selectively controlling said second motor means for reversibly driving said drive wheel means forwardly and rearwardly in response to selective positioning of said handle, said air moving means including means for conducting clean air discharged from said dirt collecting chamber means in heat transfer association with said second motor means for cooling said second motor means.

3. In a vacuum cleaner having means forming a dirt collecting chamber, a selectively positionable handle attached to said means forming a dirt collecting chamber for controlling movement of the vacuum cleaner selectively forwardly and rearwardly over a surface to be vacuum cleaned, an air conducting nozzle in communication with said dirt collecting chamber, and air moving means including first motor means for moving air through said nozzle to become dirt laden and moving said dirt laden air to said dirt collecting chamber means for removing the dirt therefrom, propelling means comprising: drive wheel means mounted on said vacuum cleaner nozzle for engaging the surface to be cleaned; second motor means carried by said vacuum cleaner nozzle and drivingly connected to said drive wheel means; and means for selectively controlling said second motor means for reversibly driving said drive wheel means forwardly and rearwardly in response to selective positioning of said handle, said air moving means including means for conducting cooling air other than the dirt laden air in heat transfer association with said second motor means for cooling said second motor means and conducting said cooling air from said second motor means to said means forming a dirt collecting chamber.

4. In a vacuum cleaner having means forming a dirt collecting chamber, a selectively positionable handle attached to said means forming a dirt collecting chamber for controlling movement of the vacuum cleaner selectively forwardly and rearwardly over a surface to be vacuum cleaned, an air conducting nozzle in communication with said dirt collecting chamber, and air moving means including first motor means for moving air through said nozzle to become dirt laden and moving said dirt laden air to said dirt collecting chamber means for removing the dirt therefrom, propelling means comprising: drive wheel means mounted on said vacuum cleaner nozzle for engaging the surface to be cleaned; second motor means carried by said vacuum cleaner nozzle and drivingly connected to said drive wheel means; and means for selectively controlling said second motor means for reversibly driving said drive wheel means forwardly and rearwardly in response to selective positioning of said handle, said air moving means including duct means for conducting air from said nozzle to said means forming a dirt collecting chamber and means for conducting cooling air other than the dirt laden air in heat transfer association with said second motor means for cooling said second motor means and conducting the cooling air from said second motor means to said duct means.

5. In a vacuum cleaner having means forming a dirt collecting chamber, a selectively positionable handle attached to said means forming a dirt collecting chamber for controlling movement of the vacuum cleaner chamber forwardly and rearwardly over a surface to be vacuum cleaned, an air conducting nozzle in communication with said dirt collecting chamber, and air moving means including first motor means for moving air through said nozzle to become dirt laden and moving said dirt laden air to said dirt collecting chambr means for removing the dirt therefrom, propelling means comprising: drive wheel means mounted on said vacuum cleaner nozzle for engaging the surface to be cleaned; second motor means carried by said vacuum cleaner nozzle and drivingly connected to said drive wheel means; and means for selectively controlling said second motor means for reversibly driving said drive wheel means forwardly and rearwardly in response to selective positioning of said handle, said drive wheel means being mounted on oppositely projecting shaft ends of said second motor means to provide a direct drive relationship between said drive wheel means and said second motor means, said air moving means including means for conducting cooling air other than the dirt laden air in heat transfer association with said second motor means for cooling said second motor means, and said drive wheel means define cup-shaped wheels having tubular side walls extending coaxially about said second motor means and having confronting distal ends spaced apart to define a flow passage for said cooling air.

6. In a vacuum cleaner structure including a suction nozzle, and air treating means including passage means extending from said nozzle, and air moving means for sucking dirt laden air through said nozzle and passage means, a first motor for operating said air moving means, dirt collecting means for removing dirt from the sucked air, and discharge means for discharging cleaned air to atmosphere, means for propelling said vacuum cleaner structure comprising: a wheeled drive mounted to said structure and including a second motor having a housing; conducting means for conducting cooling air other than said dirt laden air into and from said housing; and means for causing said air moving means to effect movement of said cooling air to provide forced internal ventilation cooling of said second motor concurrently with the suction of such dirt laden air through the nozzle.

7. The vacuum cleaner structure of claim 6 wherein said conducting means comprises second passage means and said last named means comprises means connecting said air moving means to said second passage means for directing a portion of the cleaned air to said second passage means for flow thereof through said housing and outwardly therefrom to atmosphere.

8. The vacuum cleaner structure of claim 6 wherein said conducting means comprises second passage means and said last named means comprises means connecting said air moving means to said second passage means for directing air under suction pressure from said second passage means to said air treating means.

9. The vacuum cleaner structure of claim 6 wherein said conducting means comprises second passage means and said last named means comprises means connecting said air moving means to said second passage means for directing air under suction pressure from said second passage means directly to said air moving means of said air treating means.

10. The vacuum cleaner structure of claim 6 wherein said conducting means comprises second passage means and said last named means comprises means connecting said air moving means to said second passage means for directing air under suction pressure from said second passage means to said air treating means for delivery with the sucked dirt laden air to the means for removing dirt from the air.

11. The vacuum cleaner means of claim 6 wherein said air conducting means includes outlet means axially of said second motor for discharging the motor cooling air outwardly from the housing therethrough.

12. The vacuum cleaner means of claim 6 wherein said air conducting means includes outlet means axially of said second motor for discharging the motor cooling air outwardly from the housing therethrough, and means are provided adjacent said outlet means for deflecting the discharged cooling air along the exterior of the housing for further heat transfer association with said second motor.

13. The vacuum cleaner means of claim 6 wherein said conducting means includes outlet means axially of said second motor for discharging the motor cooling air outwardly from the housing therethrough, said wheeled drive including wheels adjacent said outlet means and arranged to deflect the discharged cooling air along the exterior of the housing for further heat transfer association with said second motor.

14. The vacuum cleaner means of claim 6 wherein said wheeled drive is mounted to a carriage.

15. The vacuum cleaner means of claim 6 wherein said motor housing is fixedly mounted to a carriage.

16. The vacuum cleaner means of claim 6 wherein said air treating means includes a first duct connecting the passage means to the means for removing dirt from the air, and said connecting means comprises a second duct connecting said conducting means to said first duct.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,854,164 Dated December 17, 1974

Inventor(s) JOSEPH F. SCHMITZ

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 12, Claim 5, line 41, cancel the first word "chamber" and insert in lieu thereof --selectively--; and in line 46, after "collecting", correct the word "chambr" to --chamber--.

Signed and sealed this 22nd day of April 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks