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ELECTRICALLY PROPELLED HOUSEHOLD VACUUM CLEANER

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FIG. 1

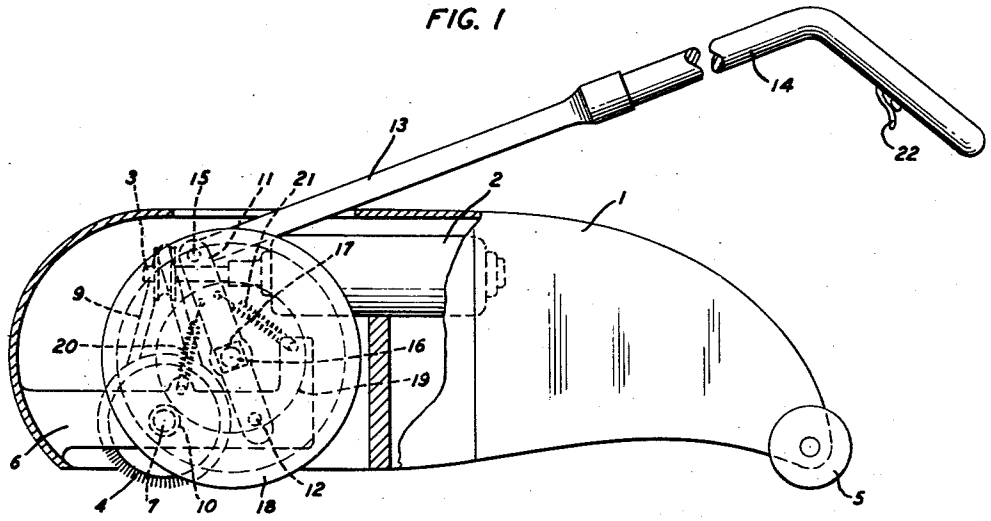


FIG. 2

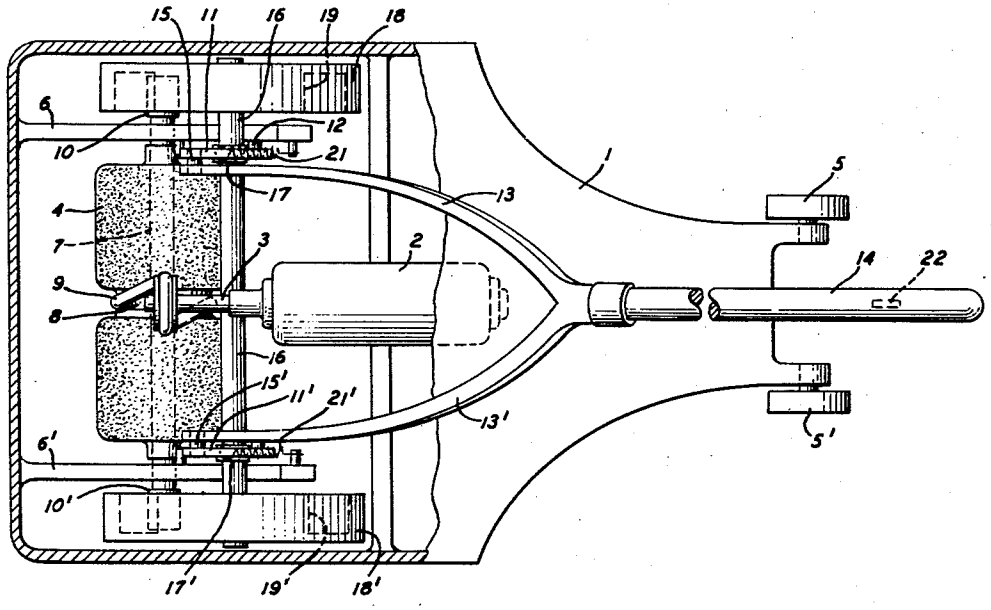


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FIG. 5

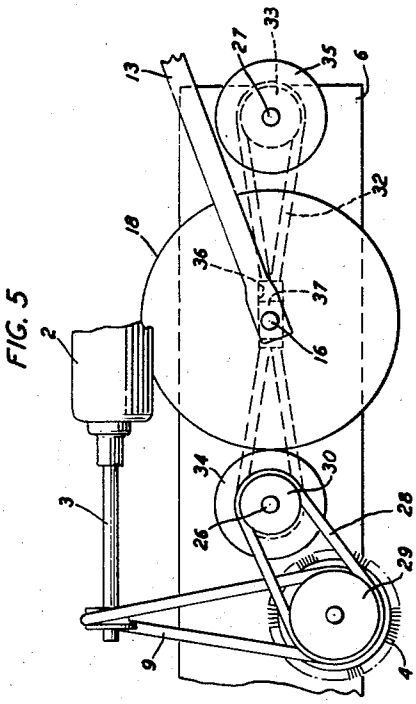


FIG. 6

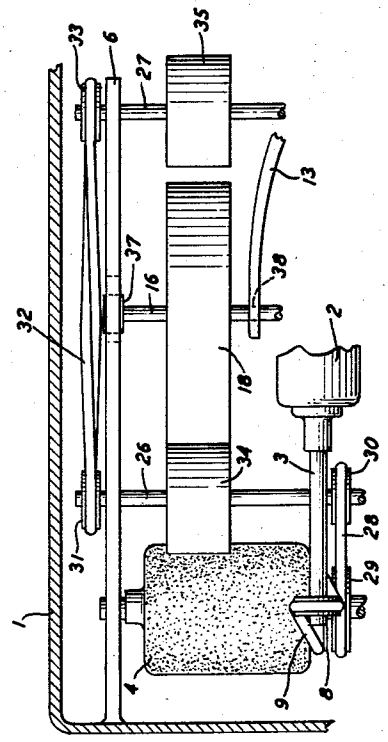


FIG. 3

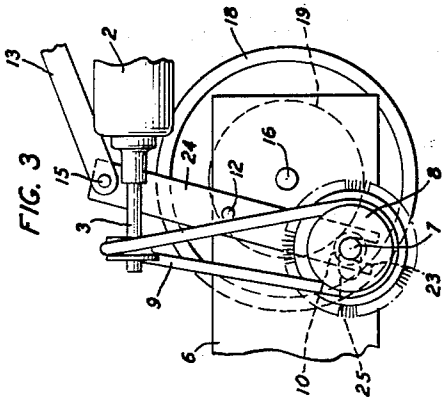
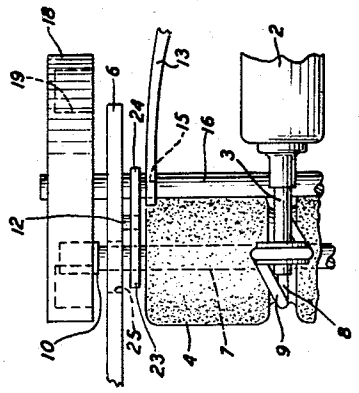


FIG. 4



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ELECTRICALLY PROPELLED HOUSEHOLD VACUUM CLEANER

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FIG. 9

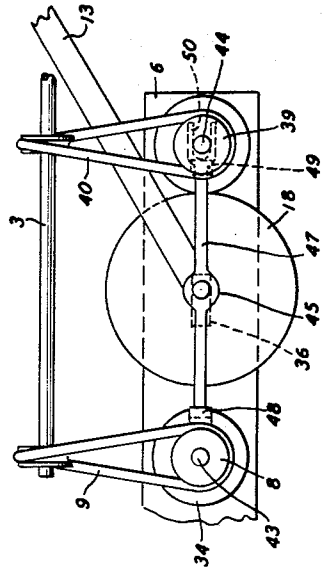



FIG. 10

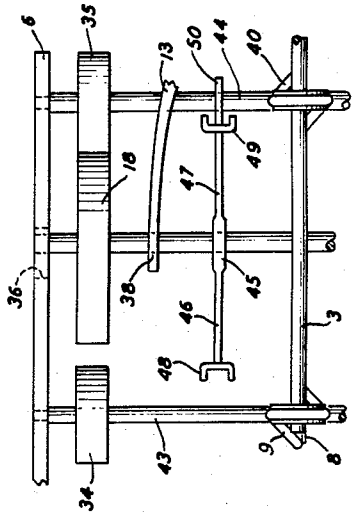



FIG. 7

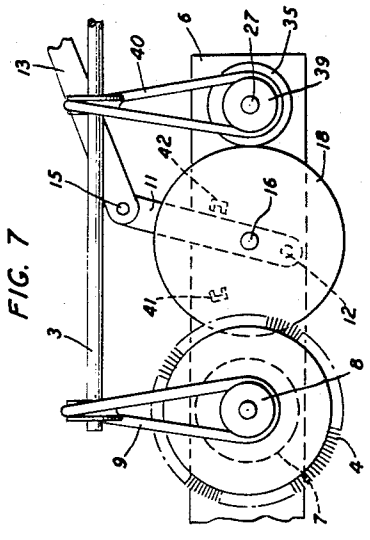
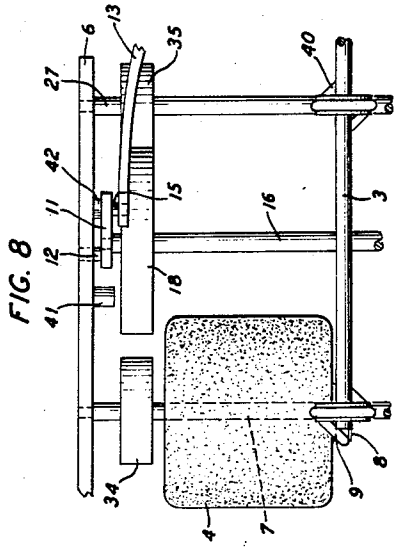



FIG. 8

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ELECTRICALLY PROPELLED HOUSEHOLD VACUUM CLEANER

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FIG. 15

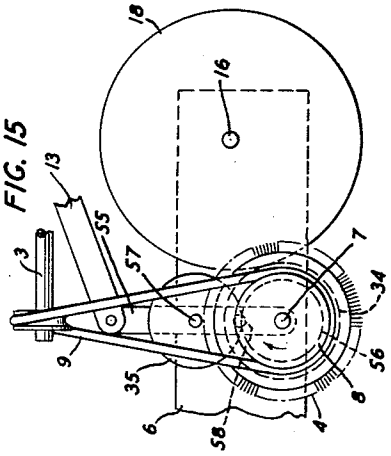


FIG. 16

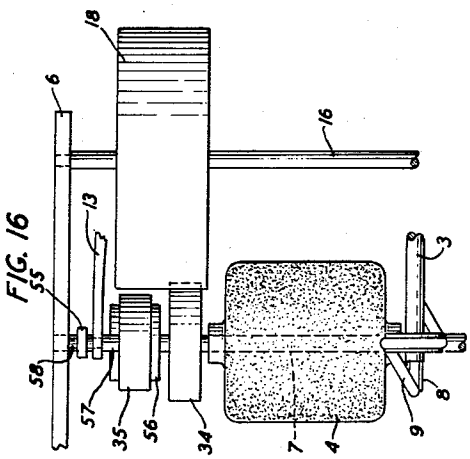


FIG. 13

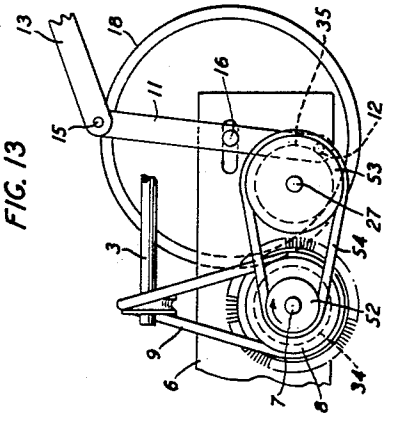


FIG. 14

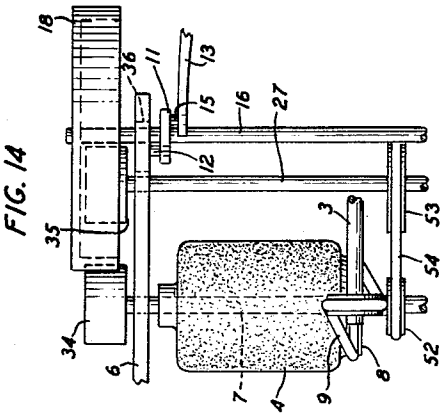


FIG. 11

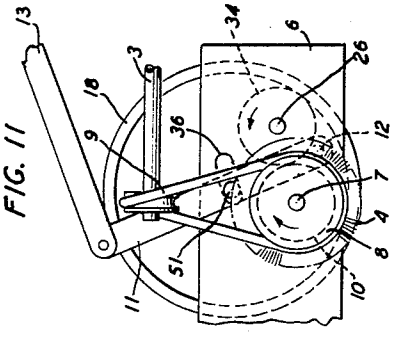
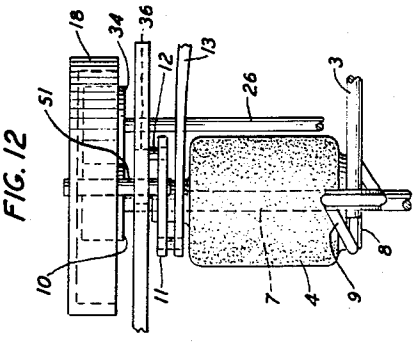


FIG. 12



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ELECTRICALLY PROPELLED HOUSEHOLD VACUUM CLEANER

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FIG. 19

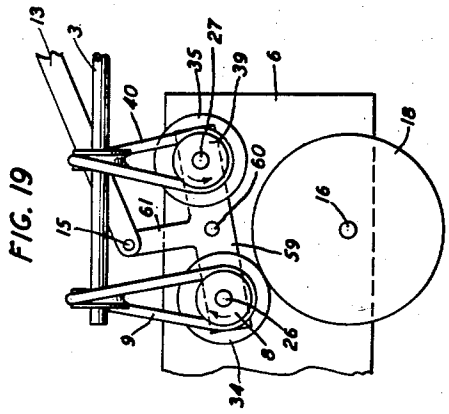


FIG. 20

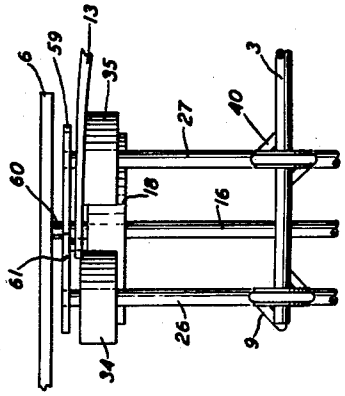


FIG. 17

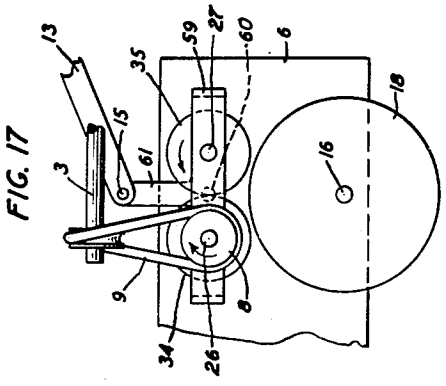


FIG. 18

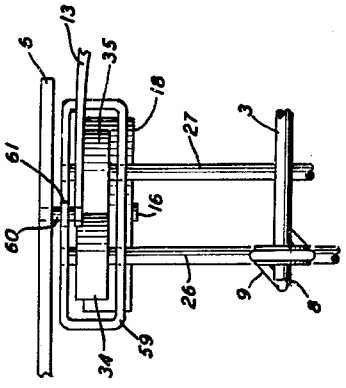


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FIG. 23

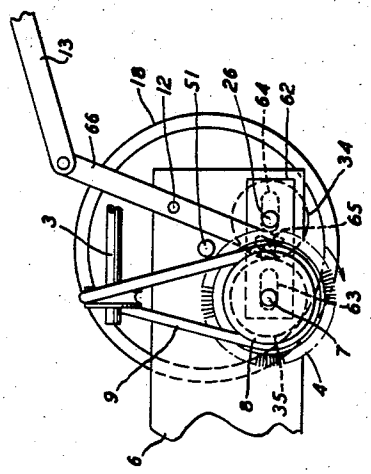



FIG. 24

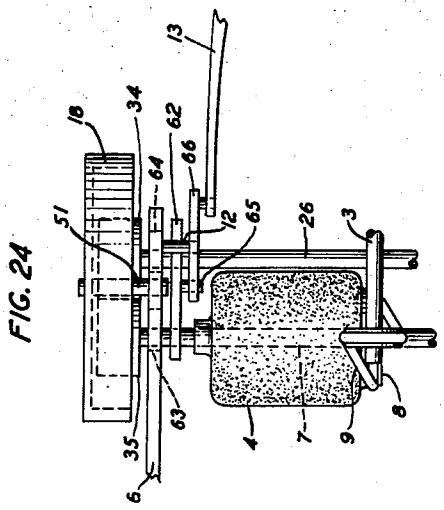



FIG. 21

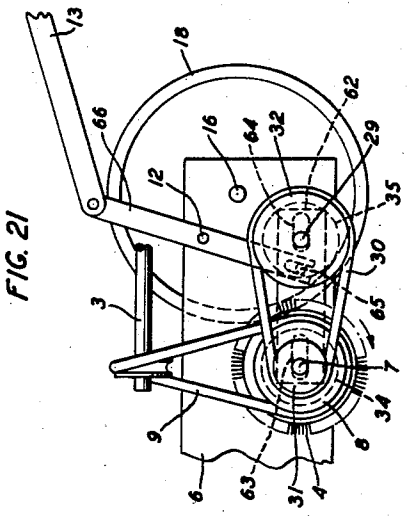
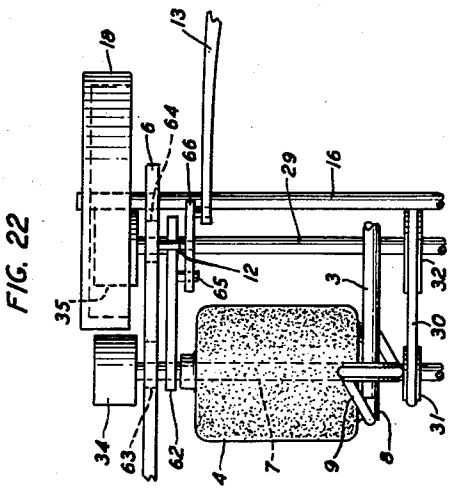



FIG. 22

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United States Patent Office 2,950,772
Patented Aug. 30, 1960



2,950,772

# ELECTRICALLY PROPELLED HOUSEHOLD VACUUM CLEANER

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Filed July 22, 1955, Ser. No. 523,677

8 Claims. (Cl. 180—6.66)

The instant invention relates to devices, such as vacuum cleaners, floor polishers, waxers, and the like, particularly of the kinds employed in the average household, which, while in the broad category of labor-saving devices, nevertheless still require appreciable physical effort on the part of the user in propelling them from place to place. The effort so required is frequently enough to prevent the use of such devices by the physically handicapped, semi-invalids and convalescents.

It is an object of the invention to reduce to a minimum the physical, generally manual, effort required to operate various devices of the type which roll on, or travel over, the surfaces on which they act, for example, vacuum cleaners, carpet cleaners, floor waxers, floor polishers, scrubbers, scrapers, sanders, lawn mowers, etc., by making the devices self-propellent by a separate motor but more generally by the electric, or other, motor already incorporated in the device for actuating the work performing element or elements thereof.

Still another object of the invention is to provide household devices of such types which are propellable in the forward and in the backward direction selectively under the control of the user.

Still another object of the invention is to provide devices of the types above mentioned with a switching means to initiate and terminate the power propulsion.

Still another object is to provide devices, for example, vacuum cleaners, for propelling the devices in both the forward and backward directions at the same speed, or with one of such speeds, usually the forward speed, greater than the other.

Still a further object of the invention is to provide vacuum cleaner devices with driving means supplying substantial assistance in making turns.

Another object is to provide increased traction between the rotatable elements of the drive of devices.

Still a further object of the invention is to provide self-aligning action for the driven roller shaft of such devices.

Still a further object of the invention is to provide such a device in which the propelling drive assumes a neutral position when not in operation.

Still a further object is to reduce the amount of time spent even by normal persons in performing the tasks for which the device, for example, a vacuum cleaner or a floor waxer and polisher, is designed by incorporating in the device the power drive unit of our invention.

Another object is to provide greater cleaning efficiency as the brush of vacuum cleaners, for example, can be designed so as to provide greater brushing action.

We accomplish the foregoing, and other, objects of the invention by providing at least one set of floor engaging rollers which is power driven by a system of driving rollers including at least one elastic belt and pulley between such set of rollers and a driving motor mounted on the device, or by any other system transmitting rotary motion, such as sprockets, chains, gearing, etc., driven by such motor. Where the motor is an electric motor, it is energized by providing a normally open switch in the handle of the device at the region where it is usually held, which switch, on grasping the handle about the switch, is closed to connect the line supply to the motor. With the motor energized, when the handle is pulled, the power transmission is so connected to the set of power driven floor engaging rollers that the device is propelled rearwardly, whereas when pushing on the handle, it is so connected thereto as to propel the device forwardly. The means for shifting the direction of power transmission includes a transversely aligned pair of levers to one end region of which the lower end of the device handle is pivotally connected, the pair of levers supporting one shaft of the power driving unit. This lever supported shaft, on which generally the power driven floor engaging rollers are mounted, may be displaced a limited amount from the true transverse direction of the device to enable making power turns by either making the levers of thin material so that they are flexible in torsion about their lengths or by mounting the shaft in flexible inserts in the levers. The main portion of the weight of the device is carried by these levers so that the rotatable elements of the drive which are longitudinally movable in the device tend to assume a neutral position in the unoperated position, since in the operating positions of the levers the other portions of the device are raised relative to the power driven floor engaging rollers.



Our instant invention will more readily be understood from the following detailed description of several illustrative embodiments thereof, in the form of power drives for vacuum cleaners of the upright type, when read in conjunction with the appended drawing in which:

Figure 1 is a somewhat simplified elevational side view of a vacuum cleaner incorporating a first illustrative embodiment of the self-propellent driving unit of our invention, in which the parts of the vacuum cleaner not essential to the understanding thereof have been omitted;

Figure 2 is a top view of the driving unit of Figure 1;

Figures 3 and 4 are the elevational side view and top view, respectively, of a modification of the first illustrative embodiment of our driving unit in which the brush shaft is movable longitudinally relative to a fixed floor roller shaft;

Figures 5 and 6 are views, respectively, of a second illustrative embodiment of our power driving unit in which the brush shaft is longitudinally fixed and the floor engaging roller shaft is longitudinally movable;

Figures 7 and 8 are views, respectively, of a third illustrative embodiment thereof in which an auxiliary drive shaft is driven directly by the motor independently of the brush shaft;

Figures 9 and 10 are views of a modification of the third illustrative embodiment in which the floor roller shaft is slidable between two auxiliary shafts;

Figures 11 and 12 are views of a fourth illustrative embodiment thereof in which the floor engaging power driven rollers house both the forward and rearward driving rollers;

Figures 13 and 14 are views of a fifth illustrative embodiment thereof in which the power driven floor engaging rollers house one set of the directional driving rollers, the other set of directional driving rollers being external to such floor engaging rollers;

Figures 15 and 16 are views of a sixth illustrative embodiment in which the driving rollers are aligned on a pair of levers rotatably supporting the brush roller, the levers being pivotable to engage one or the other set of the directional drive rollers with the floor engaging, power driven, rollers;

Figures 17 and 18 are views of a seventh illustrative

embodiment thereof in which the directional drive rollers are longitudinally aligned on brackets tiltable by the device handle to have one set only of the directional drive rollers engage the power driven floor engaging rollers at any time;

Figures 19 and 20 are views of a modification of the seventh illustrative embodiment in which each set of the directional drive rollers are independently driven direct from the motor of the device;

Figures 21 and 22 are views of an eighth illustrative embodiment in which the floor engaging roller shaft is fixed longitudinally while the brush shaft and an auxiliary drive shaft are jointly displaceable in respect thereof by a handle controlled slide member; and

Figures 23 and 24 are views of a ninth embodiment thereof which essentially is a modification of the Figures 21 and 22 embodiment with both directional drive rollers positioned within power driven, floor engaging rollers.

The vacuum cleaner incorporating the first illustrative embodiment of our invention, as shown in Figures 1 and 2, comprises essentially a formed housing **1** within which the motor **2**, by way of a drive shaft **3**, drives the brush **4** in the mouth of the suction tube of the cleaner, as also at least one fan in such suction tube which opens, in well known manner, into a dust collector or bag. The fan on rotation creates suction at the mouth of the tube thereby drawing dust laden air at such mouth into the tube and propelling it to the dust collector or bag, in well known manner. Since these latter elements are all well known in the art, only those essential to the disclosure and understanding of the instant invention are shown and referenced. The rear portion of the housing **1** is provided with a pair of transversely aligned rollers **5**, **5'**, so supported therefrom that with the brush and these rollers on the floor, the drive shaft **3** is in a predetermined position, for example, horizontal.

It is to be understood that the parts so far enumerated may be of any prior known type, and also that a primed reference character means that a like element is transversely opposite the non-primed element in the particular embodiment. Like reference characters in the various figures of the drawing designate like elements in the respective embodiments. For simplicity of the showing in the drawing, all the top views with the exception of that of Figure 2, show only that half of the device containing the non-primed element of a pair.

The self-propelled unit of our first embodiment has a pair of frame members **6**, **6'** supported within the housing **1**, each frame member being spaced from the lateral walls thereof and extending longitudinally therein. The brush **4** is fast on the brush shaft **7** which is rotatably supported at its end regions in the forward portions of the frame members **6**, **6'**, the brush side of the illustrative embodiments being designated the forward end of the devices described and illustrated in this application. The brush is driven by way of the pulley **8** integral with the midregion of the shaft **7**, belt **9**, and the motor shaft **3**, the brush motion being in the clockwise direction as viewed in Figure 1 such that the tufts of the brush sweep forwardly on the floor at all times irrespective of the direction the device itself is moving. The ends of the brush shaft **7** extend transversely beyond the frame members and carry rollers **10**, **10'** integral therewith, or are themselves formed as such rollers. At the rearward regions of the frame members **6**, **6'**, the lower ends of the levers **11**, **11'** are pivoted at **12**, **12'**, with the upper ends of such levers pivotally connected to the forked ends **13**, **13'** of the device handle **14** at **15**, **15'**. The forked ends **13**, **13'** extend through the device housing by way of appropriate apertures. A shaft **16** is fixedly mounted transversely in the vacuum cleaner in the levers **11**, **11'** at an intermediate region thereof above the frame members **6**, **6'**. To permit of slight deflections of the shaft **16** from its normal position substantially perpendicular to the levers **11**, **11'**, the shaft **16** may be journalled in resilient inserts **17**, **17'** in such levers. We prefer, more generally, to use plain bearings for journalling the shaft in the levers and to make the latter flexible in torsion of their length by making them of relatively thin metal or other material and pivoting them through their thickness. Rotatably mounted on the respective ends of the shaft, and spaced from both the frame members **6**, **6'** and the lateral walls of the housing **1**, the floor rollers **18**, **18'** are cup-shaped with their open ends facing inwardly, that is, toward each other. Coaxial with and situated within the interior of the floor rollers **18**, **18'**, the rollers **19**, **19'** are integral therewith and of such diameter relative to that of rollers **18**, **18'** that when rollers **10**, **10'**, which are positioned in the interior of rollers **18**, **18'** engage the interior cylindrical surfaces of rollers **18**, **18'**, they are disengaged from the rollers **19**, **19'**, and vice versa. A pair of matched springs **20**, **21** and **20'**, **21'**, each anchored at one end in the frame members **6**, **6'** and connected with its other end to the upper ends of levers **11**, **11'**, returns the levers **11**, **11'** to a neutral position when the handle **14** is released.

An electric line switch **22** which is spring biased to its open position, is provided in the handle **14** at the upper region thereof where it is normally grasped by the user; of which switch, the blade, appropriately insulated, extends outwardly from the handle. When the user encircles the handle at that region with his hand, the switch blade is depressed to close the circuit, connecting the line current by way of the usual plug to the motor **2**.

In operation, the handle having been grasped to close the switch **22** and start the motor **2**, the brush **4** is rotated, as above stated, clockwise, and hence also the rollers **10**, **10'** integral therewith. Pushing the handle **14** longitudinally forward, the levers **11**, **11'** pivot about **12**, **12'** to move the shaft **16** in the forward direction until the cylindrical surfaces of the rollers **19**, **19'** engage the clockwise rotating rollers **10**, **10'**, driving the rollers **19**, **19'** counterclockwise. Hence the integral floor rollers **18**, **18'** are driven counterclockwise and the device is propelled forwardly. Just so long as the slightest of longitudinal pushes is maintained on the handle, the rollers **18**, **18'** will be driven counterclockwise and continue the propulsion in the forward direction. However, if a longitudinal pull is exerted on the handle, the levers pivoting about **12**, **12'** will move the shaft **16** in the rearward direction until the interior cylindrical surfaces of the floor rollers **18**, **18'** are engaged by the clockwise rotating rollers **10**, **10'**, driving the floor rollers clockwise and propelling the vacuum cleaner in the rearward direction just so long as the slightest of longitudinal pulls is maintained on the handle.

If now it is desired to negotiate a curve or turn with the vacuum cleaner, the handle **14** is pulled laterally in the direction opposite that of the desired turn, this being a normal and quite usual maneuver. Thus, as viewed in Figure 2, if the vacuum cleaner is to make a forward turn upwardly, the handle **14** at its grasped upper end at the switch **22** would be deflected downwardly while pushed forwardly. In so doing, the fork **13** would pull the lever **11** rearwardly about its pivot **12** causing the interior surface of the roller **18** to engage the roller **10**, which, rotating clockwise, drives the roller **18** clockwise and rearwardly, whereas the fork **13'** would push the lever **11'** forwardly to cause the roller **19'** to engage the roller **10'** and to drive the roller **18'** counterclockwise and forwardly. It will be noted that the resilient inserts **17**, **17'** in the levers permit of the required deflection of the shaft **16** involved in these power turns.

In the first illustrative embodiment just described, the roller **19** being of a smaller diameter than the floor engaging power driven roller **18**, and both being driven by the roller **10** when in engagement, with the roller **19** in the forward direction and with the inner cylindrical surface of the roller **18** in the reverse direction, the forward speed of the vacuum cleaner of this embodiment exceeds the backward speed thereof.

In the modification of the first illustrative embodiment shown in Figures 3 and 4, instead of the position of the power driven, floor engaging rollers being controlled, the brush is so controlled toward and away from the spatially fixed position of the floor rollers. In this modification, the brush shaft 7 extends between the forks 23, 23' at the lower ends of the levers 24, 24' which are pivoted at the intermediate region 12, 12' in the frame members 6, 6'. As before, the rollers 10, 10' are integral with the ends of the brush shaft 7, which shaft extends through horizontal, elongated apertures 25, 25' in the frame members, while the upper ends of the levers 24, 24' are pivotally connected to the forked ends 13, 13' of the handle 14. The shaft 16 is supported spatially fixed in the frame members and, also as before, the floor engaging rollers 18, 18', with the forwardly drive rollers 19, 19' internally thereof, are rotatably supported on the ends of shaft 16. As the handle 14 is pushed forward, the shaft 7 moves rearward in the elongated slots 25, 25' to engage the rollers 10, 10' to the forward rollers 19, 19' to propel the vacuum cleaner forwardly, while when the handle is pulled rearwardly, the brush shaft 7 and the rollers 10, 10' are moved forward in the elongated horizontal slots 25, 25' and away from the rollers 19, 19' to engage the interior cylindrical surface of the floor rollers 18, 18' to propel the vacuum cleaner rearwardly.

In the second illustrative embodiment, see Figures 5 and 6, the brush shaft is again longitudinally fixed while the floor roller shaft is longitudinally displaceable to cause the floor rollers to engage either the forward drive, or the rearward drive, rollers, each pair of directional drive rollers being on an auxiliary shaft which is belt driven. A first auxiliary shaft 26 is rotatably supported in the forward regions of the frame members 6,6' and a second auxiliary shaft 27 is rotatably supported in the rearward regions thereof. A belt 28 over the pulley 29 rigidly fastened to the transverse midregion of the brush shaft, by way of pulley 30 integrally on shaft 26, rotates the latter shaft in the same direction as that in which the brush rotates. At one end region of the shaft 26, between the frame member 6 and the adjacent wall of the housing 1, for example, the pulley 31 integrally thereon, by way of the crossed belt 32, drives the pulley 33 integrally on the shaft 27 in the opposite direction. The shaft 26 has a pair of integral rollers 34, 34' spaced thereon, while the shaft 27 has a pair of integral rollers 35, 35' spaced thereon, the rollers 34 and 35 being longitudinally aligned with each other, as are rollers 34' and 35'. In the transversely aligned slots 36, 36' through the frame members 6, 6', the slidable bearings 37, 37' are respectively supported, the bearings mounting the shaft 16 on the ends of which the independently rotatable and spaced floor rollers 18, 18' are mounted. At intermediate transverse regions 38, 38', the shaft 16 is rotatably connected to the forked ends 13, 13' of the handle 14. The diameter of the floor rollers 18, 18' is less than the distance between the most adjacent peripheral regions of the roller pairs 34 and 35, and 34' and 35', that is, on engagement of the cylindrical surface of each floor roller with one roller of the aligned pair of rollers, such surface is disengaged from the other roller of the pair. The length of the slots 36, 36' and of the bearings 37, 37' is such that when the bearings almost abut one end of the respective slots, the floor roller is engaged to one drive roller of the pair and disengaged from the other roller of the pair, while when the bearings almost abut the other end of the slots, the floor roller engages the other drive roller of the pair. In the embodiment of Figures 5 and 6, just described, we have made the forward, 34, 34', and the rearward, 35, 35', drive rollers of the same diameter and rotate their integral shafts 26 and 27 at the same speeds. But, as in other embodiments herein described, the forward propelling speed may be made to differ from the rearward speed by appropriately dimensioning the diameters of the drive rollers or by appropriate change in the speed of their respective shafts, or by a combination of both.

In the third illustrative embodiment, shown in Figures 7 and 8, the driving shafts of the forward and the rearward driving rollers are driven independently of each other by direct belting from the motor to each driving shaft and at the same speed, but the forward driving rollers are made larger in diameter than the rearward drive rollers, so that the forward speed of the vacuum cleaner is greater than its rearward speed. In this embodiment the forward driving rollers 34, 34' are integral at each end of the brush shaft 7, which is belt and pulley driven from the motor as in the previously described embodiments, and similarly the rollers of the rearward driving pair are integral on the rearwardly positioned auxiliary shaft 27 driven by its integral pulley 39 through the belt 40 from the motor shaft 3 in the direction opposite to that in which the brush shaft 7 is driven, but at the same speed since brush shaft pulley 8 and auxiliary shaft pulley 39 have equal diameters. In this embodiment also, the floor rollers 18, 18' turn independently of shaft 16 of which the ends are supported in the levers 11, 11', the latter being pivoted at their lower ends on pins 12, 12' in the frame members 6, 6', the pins 12, 12' being located about midway between shafts 7 and 27. It will be noted that the spacing between the rollers 34, 34' on the brush shaft 7 and the rollers 35, 35' on the auxiliary shaft 27 is such that with the levers 11, 11' pushed forwardly to cause the floor rollers 18, 18' to engage the forward drive rollers, there is complete disengagement between the floor rollers and the rearward drive rollers, whereas when the levers are pulled rearwardly to cause the floor rollers to engage the rearward drive rollers, there is complete disengagement between the floor rollers and the forward drive rollers. To maintain more effective contact between the engaging rotating surfaces of the rollers, a pair of magnets 41, 42 and 41', 42' are supported on the frame members in the path of movement of the lever arms 11, 11' to act on the levers in their forward pushed and rearward pulled positions by attracting them and tending to hold the levers thereagainst in the one position by magnets 41, 41', in the other by magnets 42, 42'. While the shaft 16 might be provided with self-aligning bearings in the levers 11, 11', as in the Figures 1 and 2 embodiment, here the aligning requirement is satisfied with plain bearings for the shaft in the levers, since the latter are made flexible in the torsional direction about their length by making them of relatively thin material, preferably metal, pivoted through their thickness as shown.

It is to be noted that as the shaft 16 is swung from the rearmost position, where floor rollers 18, 18' engage the rearward drive rollers 35, 35', to the most forward position, where the floor rollers engage the forward drive rollers 34, 34', the shaft borne by the levers 11, 11' travels in an arc rather than along a chord, resulting in varying the height of the machine from the floor. The extreme motion longitudinally of the shaft 16 need only be of the order of ⅛ inch, and hence the vertical component producing the upward movement of the machine as the shaft is swung from its neutral position in either direction will be of the order of about 1/50 inch, which is of such order as not to affect the operation of the vacuum cleaner. The weight of the machine then acts as a force tending to restore the vertical alignment of shaft 16 and the pivot pins 12, 12' having a moment arm equal to the distance the shaft 16 has been longitudinally displaced relative to the pivots 12, 12'. The levers 11, 11' will thus assume this neutral position just as soon as the handle 14 is neither pushed nor pulled.

In a variation of the third illustrative embodiment, shown in Figures 9 and 10, the floor roller shaft is slidable longitudinally, rather than swingable by being mounted in a pair of levers, and the directional drive rollers are of equal diameter. The forward drive rollers

34, 34' are integrally affixed to the shaft 43 of magnetic material rotatably mounted in the forward region of the frame members 6, 6'. The rearward drive rollers 35, 35' are integrally affixed to shaft 44 of magnetic material rotatably supported in the rearward region of the frame members. Both auxiliary shafts are belt driven in opposite directions direct from the motor, shaft 43 by the belt 9 and the pulley 8, shaft 44 by the belt 40 and the pulley 39. The floor roller shaft 16 is slidable in the elongated apertures 36, 36' in the frame members and at transverse intermediate regions 38, 38' thereof is rotatably connected to the forked ends 13, 13' of the device handle 14. A connecting member 45 has its central portion connection to the shaft 16, and has a forwardly extending rod 46 and a rearwardly extending rod 47, each rod having a magnet 48 and 49, respectively, at its free end. The rearwardly extending rod 47 also has a yoke 50 at its free end straddling the shaft 44 at all times irrespective of the amount of longitudinal displacement of the connecting member 45 either forwardly or rearwardly. When the shaft 16 is pushed forward by means of handle 14, connecting member 45 is displaced forwardly and magnet 48 attracts shaft 43, thus tightly engaging the forward drive rollers 34, 34' to floor rollers 18, 18', while when the connecting member is displaced rearwardly, magnet 49 attracts shaft 44 to tightly engage the rearward drive rollers 35, 35' to the floor rollers.

In the fourth illustrative embodiment of our power drive unit shown in Figures 11 and 12, the floor rollers 18, 18' house both the forward drive rollers and the rearward drive rollers, the forward drive rollers being rotatable on an auxiliary shaft supported in the frame members. The ends of the auxiliary shaft 26 extend through the frame members 6, 6' so as to position the forward drive rollers 34, 34' within the floor rollers 18, 18' while the drive rollers 10, 10' are fixed on the respective ends of the brush shaft 7. To permit the passage of the rollers 10, 10' and 34, 34' into the floor engaging, power driven rollers, the latter are open on their faces adjacent respectively to the frame members 6, 6'. As in the first embodiment, the brush shaft is rotated from the motor shaft 3 by way of the belt 9 and the brush shaft pulley 8. The floor rollers 18, 18' are rotatably supported on the stub shafts 51, 51' of which the non-roller ends pass through the frame members 6, 6' and are fixedly supported in the levers 11, 11' at a region thereof above the pivot pins 12, 12' thereof in the frame members. To permit the shifting forwardly and rearwardly of the stub shafts by the lever arms, the elongated apertures 36, 36' are provided in the frame members, the stub shafts passing through the apertures. The forward drive roller shaft 26 is fixed in the frame members at a distance from the brush shaft 7 so that at all times the roller 10 engages the roller 34 and the roller 10' engages the roller 34' to drive the rollers 34, 34' in the opposite direction. The diameters of the drive rollers 34, 34' and 10, 10' are such that, coupled with the positioning vertically of the brush shaft 7 and the auxiliary shaft 26 below the stub shafts 51, 51', when one pair of the drive rollers 34, 34' engage the cylindrical interior surface of the floor rollers 18, 18', the other pair of drive rollers 10, 10' are disengaged from such surface.

In operation, when the handle 14 is pushed forward, the levers 11, 11' force the stub shafts 51, 51' forward towards the forward ends of the apertures 36, 36', thus moving the floor rollers 18, 18' forward to bring the inner cylindrical surfaces thereof into engagement with the forward driving rollers 34, 34' and driving the floor rollers counterclockwise and the vacuum cleaner forward. On the other hand, when handle 14 is pulled, the levers move the stub shafts rearward toward the rearward ends of the apertures and move the floor rollers rearward to engage their inner cylindrical surfaces with the rearward drive rollers 10, 10' which rotate the floor rollers in a clockwise direction and cause the vacuum cleaner to move in the rearward direction. Different forward and reverse speeds can be obtained by the use of an auxiliary roller on either the shaft 7 or shaft 26 in the manner similar to that used in the sixth embodiment. Power turns of the device are possible to either the right or left of the direction of device motion by suitably deflecting the handle 14 to the left or right, respectively, in the same manner as above described for the first embodiment. Due to the mechanical advantage of the levers 11, 11', increased traction between the floor rollers and the drive rollers is obtained.

In the fifth illustrative embodiment, shown in Figures 13 and 14, only the rearward drive rollers 35, 35' are disposed within the floor rollers 18, 18' and are belt driven from the brush shaft 7, on which the forward drive rollers 34, 34' are integrally mounted. The brush shaft 7 is belt driven from the motor through the pulley 8 which is relatively large as compared to the pulley 52 integral on the brush shaft. By way of pulley 52, the backward drive roller shaft 27 is driven by the large pulley 53 integral on such shaft, and the belt 54. Even though the forward drive rollers 34, 34' are of the same diameter as the backward drive rollers 35, 35', there results a higher forward than backward speed of the floor rollers 18, 18' because the pulley 53 driven by the pulley 52 is larger than the latter, making the speed of the shaft 27 integral with the rollers 35, 35' slower.

In the sixth illustrative embodiment, shown in Figures 15 and 16, the brush shaft 7 is supported by a pair of levers 55, 55' and the forward drive rollers 34, 34' are integrally mounted on the ends of the brush shaft. The brush shaft also carries the integral intermediate drive rollers 56, 56' of which the cylindrical surfaces engage those of the rearward drive rollers 35, 35' rotating the latter in the opposite direction. The purpose of rollers 56, 56' is to provide means for different forward and reverse speeds. The stub shafts 57, 57' of the rearward drive rollers 35, 35' are supported in the levers 55, 55' above the brush shaft 7. At the regions of the levers aligned horizontally with the line of contact of the rollers 56, 56' with the rollers 35, 35', the levers are pivoted on pins 58, 58' to the frame members 6, 6', the upper ends of the levers 55, 55' being pivoted to the forked ends 13, 13' of the device handle 14. The floor roller shaft 16 is fixedly supported in the frame members 6, 6' at such distance that the cylindrical surfaces of the floor rollers 18, 18', rotatable on shaft 16, are engageable by the forward drive rollers 34, 34' when the handle is pushed, and by the rearward drive rollers 35, 35' when the handle is pulled. It will be noted that the pivot pins 58, 58' are so located that on pulling the handle, the forward drive rollers, driven clockwise, will be sufficiently moved away from the floor rollers to permit the rearward drive rollers to engage the outer cylindrical surface of the floor rollers and cause them to rotate clockwise and move the device rearwardly. In like manner, the forward motion of the device is obtained by pushing the device handle forward, thus causing the drive rollers 35, 35' to disengage from the floor rollers, and the drive rollers 34, 34', still driven clockwise, to engage the floor rollers and rotate them counterclockwise to move the device forward. In the event that equal forward and backward speeds are required, the diameter of rollers 56 and 34 should be the same size; in fact, the two rollers can be one.

In the seventh illustrative embodiment, shown in Figures 17 and 18, the drive rollers are rotatably supported in tiltable brackets pivoted on the frame members, so that only one set of drive rollers engages the floor rollers on pushing or pulling the handle of the device. The brackets 59, 59' are pivoted at about their mid-region longitudinally at the pins 60, 60' to the frame members 6, 6', and have the lower end of links 61, 61' fixedly connected to the brackets, respectively, the upper ends of the links being pivotally connected to the handle

forks 13, 13'. The forward drive rollers 34, 34', and the rearward drive rollers 35, 35', are rotatably supported at the respective end regions of the brackets with their outer cylindrical surfaces in rolling contact with each other at all times. The forward drive rollers are belt driven clockwise from the motor, thus driving the contacting rearward drive rollers counterclockwise. Thus when the device handle 14 is pushed, the forward drive rollers are tilted to engage the floor rollers, driving the device forward; while, when the handle is pulled, the brackets are tilted in the opposite direction to engage the backward drive rollers to the floor rollers and drive the device rearward.

In the modification of the seventh embodiment shown in Figures 19 and 20, each set of forward drive and of rearward drive rollers, rotatably supported in tiltable brackets, is belt driven directly from the motor. As before, the brackets 59, 59' are pivoted about substantially their midregions on pins 60, 60' in the frame members 6, 6', and the links 61, 61' integral with and extending substantially perpendicularly upward from the brackets have their upper ends pivotally connected to the forked lower ends of the device handle. The forward drive rollers 34, 34', integral with auxiliary shaft 26 rotatably mounted in the forward region of the brackets, are driven directly to rotate clockwise from the motor shaft 3 by way of belt 9 therefrom to pulley 8 on shaft 26. Similarly, rearward drive rollers 35, 35', fast on auxiliary shaft 27 which is rotatably supported at the rearward region of the brackets, are directly driven to rotate counterclockwise from motor shaft 3 by way of belt 40 therefrom to pulley 39 integral on shaft 27. In this modification, the outer surfaces of drive rollers 34, 34' and 35, 35' do not ever engage each other and are so spaced from each other and in relation to floor rollers 18, 18' that when the forward drive roller of a longitudinally aligned pair of drive rollers in a bracket engages the floor roller aligned with such pair, the rearward drive roller of such pair is disengaged therefrom, and vice versa. As in other embodiments herein described, the forward propelling speed may be made to differ from the rearward speed by appropriately dimensioning the diameters of the drive rollers or by appropriate change in the speed of their respective shafts, or by a combination of both. The operation of the seventh embodiment and its modification, including power turns, is perfectly obvious from the prior described detailed operation of hereinbefore described embodiments.

In a further and eighth embodiment, shown in Figures 21 and 22, the floor roller shaft is longitudinally fixed and the directional drive rollers are on slidably movable members actuated by the handle through lever arms interconnecting the slide members and the handle, one set of the drive rollers being disposed within the floor rollers. The floor roller shaft 16 is fixed in the frame members 6, 6' and the floor rollers 18, 18' are rotatably supported on the ends of such shaft extending beyond the frame members. The brush shaft 7 is rotatably supported in the longitudinal slide members 62, 62' and extends through the longitudinal slots 63, 63' in the frame members 6, 6', the ends of the shaft 7 carrying the forward drive rollers 34, 34' longitudinally aligned with the floor rollers. The brush shaft 7 is belt driven from the motor in the clockwise direction and is movable in the slots 63, 63' an amount sufficient to engage and disengage the drive rollers thereon with, and from, the floor rollers depending on the longitudinal position of the slide members 62, 62'. An auxiliary shaft 27 is also rotatably mounted in the slide members 62, 62' and is driven by belt 30 from pulley 31 on the brush shaft to pulley 32 integral on the shaft 27, the latter extending through the longitudinal slots 64, 64' in the frame members. The ends of the shaft 27 integrally support the rearward drive rollers 35, 35' disposed within the cup shaped floor rollers 18, 18' and adapted on longitudinal movement of the slide members to engage, and be disengaged from, the inner cylindrical surface of the floor rollers. The pins 65, 65' integral with the slide members are engaged between the forked ends 23, 23' of the levers 66, 66' pivoted at intermediate points on the frame members and connected pivotally at their upper ends to the forked ends 13, 13' of the handle 14. It will be noted that since the shaft 16 is above the slide members, this shaft does not interfere with the longitudinal movement of the slide members. When the handle is pushed forward, the slide members 62, 62' move longitudinally rearward to cause the forward drive rollers 34, 34' to engage the floor rollers, at the same time disengaging the rearward drive rollers 35, 35' from the interior cylindrical surfaces of the floor rollers. When the handle is pulled rearward, the slide members move longitudinally forward to cause the rearward drive rollers 35, 35' to engage the interior surfaces of the floor rollers, while disengaging the forward drive rollers from the floor rollers. Slide members 62, 62' being of relatively thin material, are flexible in torsion about their lengths and thus permit of power turns by deflecting the device handle 14 sideways in the normal manner from the direction of device movement in the manner hereinbefore described for other embodiments.

The ninth illustrative embodiment of the power drive, shown in Figures 23 and 24, is essentially the structure of the embodiment of Figures 21 and 22 as applied to a power drive unit in which both directional drive rollers are disposed within the floor rollers. In the instant embodiment, the floor rollers 18, 18' are rotatable on the stub shafts 51, 51' supported in the frame members 6, 6', the stub shafts being positioned above the slide members 62, 62'. The forward drive rollers 34, 34' are driven by continued direct rolling contact with the belt driven rearward drive rollers 35, 35', which have the same diameter as rollers 34, 34'. This results in the rollers 34, 34' rotating counterclockwise and the rollers 35, 35' rotating clockwise, assuming the brush is turning clockwise. Both of the directional drive rollers engage, and are disengaged from, the interior cylindrical surfaces of the floor rollers in accordance with the longitudinal displacement of the slide members, such that when the handle is pushed forward, the forward drive rollers engage such surfaces while the rearward rollers disengage therefrom, and vice versa on pulling the handle rearward. With these exceptions, the structure and the operation including power turns, of the instant embodiment are the same as those of the eighth embodiment shown in Figures 21 and 22.

It is to be understood that the embodiments in respect of which the electric switch 22 is neither shown nor discussed, do in fact, have such switch in the handle 14, and that in all of the embodiments, with the switch closed, on a forward push of the handle of the device, the device will be power propelled forward; on a rearward pull on the handle, the device will be power propelled rearwardly, and on deflection of the handle from the direction of device movement, the power unit will propel the device in a turn depending on the direction of handle deflection. Likewise all embodiments will have supporting floor rollers, such as 5, 5' in Figures 1 and 2, not necessarily power driven, to maintain the device substantially horizontal.

It is obvious that the particular speed at which the device, in which our power drive unit is incorporated, is propelled forwardly or rearwardly, is a matter of the relative dimensioning of the various rotatable elements participating in the drive. For the belts shown in the several illustrative embodiments, pulleys, gearing, sprockets and chains, etc., may readily be substituted. Holding magnets, of the types shown in Figures 7 and 8 or in Figures 9 and 10, may obviously be used to retain the appropriate rollers in contact on pulling or pushing the device handle in any of the embodiments. All embodiments may also be provided with the equalized springs

shown in Figures 1 and 2 to assist in restoring the movable portion of the roller assembly to the neutral position in the absence of a push or pull on the handle. Furthermore, all the embodiments disclosing the drive and floor rollers between the frame members may have them outside the frame members, that is, between a frame member and the adjacent lateral wall of the device, while those shown with such rollers outside the frame members may have them therebetween. In all of the embodiments in which such rollers are between the frame members or outside of them, the frame mmbers may be the lateral walls of the device per se. The embodiments which show drive rollers within the floor engaging, power propelled rollers may be modified to have some or all of the drive rollers outside of the floor rollers, and vice versa. The motor actuating the power drive unit of our invention may be a separate motor individual to such drive, rather than the motor already built into the device to actuate its other functions. All embodiments having levers may, in their stead, have slide members supporting a shaft of the drive, while all embodiments not showing levers may have them in place of the slide members shown.

Various other changes will suggest themselves to the skilled worker in the art without departing from the teaching of the instant invention, for it is to be expressly noted and understood that the embodiments shown are disclosed not by way of limitation and that our invention is as broad as the prior art permits and as defined in the appended claims.

What we claim is:

1. A propelling unit for household devices rollable on floors comprising at least one pair of cup-shaped device supporting rollers, a drive roller associated with each supporting roller, a central cylindrical post coaxial and integral with the supporting roller and extending in the same direction axially as the cup wall thereof, the associated drive roller being positioned within the groove formed between the cup wall and the cylindrical post surface and normally out of contact with both and of a diameter selectively to engage but one of the cup wall and the cylindrical post surface at a time, a device handle, the pair of supporting rollers being aligned and spaced from each other substantially at right angles to the handle, motor means on the device for rotating all the drive rollers in a predetermined direction, and means supporting each drive roller and its cooperating supporting roller for relative longitudinal movement under the control of the handle for selectively propelling the device forward on pushing the handle, rearward on pulling the handle, and in a turn on deflecting the handle to the side of the desired turn while pushing or pulling.

2. A vacuum cleaner comprising a first shaft, a plurality of cleaner supporting rollers of which at least one pair is rotatable about the first shaft at opposite end regions thereof, each of the pair of cleaner supporting rollers having two inner cylindrical surfaces concentric with the roller and radially spaced from each other, a second shaft rotatably supported, electrical means for driving the second shaft in one direction, a drive roller at each end region of the second shaft extending into the cleaner supporting roller pair between the two cylindrical surfaces thereof and of a diameter less than the radial spacing between such two inner surfaces, and means selectively to engage the drive roller at one end of the second shaft with the inner cylindrical surface of the greater radius while simultaneously engaging the drive roller at the other end of the second shaft with the inner cylindrical surface of the lesser radius of the respective cleaner support rollers and to engage both drive rollers simultaneously to the corresponding inner cylindrical surfaces of the respective cleaner support rollers of the pair.

3. A vacuum cleaner propelling unit according to claim 2 in which the means for selectively engaging the drive rollers with the pair of supporting rollers comprises a rectangular frame member, a lever pivoted at its lower end to each side of the frame member, a handle, the two levers being connected at their respective upper ends to the handle, and a yieldable resilient bearing in each lever intermediate the ends thereof in which the second shaft is rotatably supported.

4. A household vacuum cleaner propelling unit comprising a first shaft transverse to the cleaner, a cleaner supporting roller at each end region of the first shaft, first and second cylindrical surfaces coaxial with and formed within each cleaner supporting roller, a pair of spaced frame members extending longitudinally in the cleaner, a second shaft rotatably supported in the frame members, a drive roller integral with each end region of the second shaft and normally disengaged from both the first and second cylindrical surfaces, motor means on energization rotating the second shaft, a pair of spaced levers, a resilient bearing at an intermediate region of each lever supporting an end region of the first shaft, each lever being pivoted in the frame member at its lower end, a handle, and a pivotable connection between the upper end region of each lever and the handle whereby on pushing the handle longitudinally forward, the drive rollers on the second shaft are engaged to the first driven cylindrical surfaces of the supporting rollers to propel the cleaner in the forward direction, on pulling the handle longitudinally backward the drive rollers are engaged to the second cylindrical surfaces of the supporting rollers to propel the cleaner in the rearward direction, and on deflecting the handle laterally while pushing, one drive roller of the second shaft is engaged to the first cylindrical surface of one supporting roller to rotate it in the cleaner forward propelling direction and the other drive roller is engaged to the second cylindrical surface of the other supporting roller to rotate that roller in the cleaner rearward propelling direction, whereby the cleaner is propelled in a turn.

5. A household vacuum cleaner according to claim 4 in which each cleaner supporting roller is cup shaped with the open end facing the midregion of the first shaft, the motor means rotates the second shaft and its drive rollers clockwise, and the drive rollers are positioned within the cleaner supporting rollers between and spaced from the first and second cylindrical surfaces thereof.

6. A household vacuum cleaner propelling unit according to claim 4 in which each of a pair of tension springs on opposite sides longitudinally of each lever has one end anchored in the upper end region of the lever and its other end anchored in the frame member to which the lever is pivoted, whereby the lever tends to assume a neutral position in the absence of a force acting on the handle.

7. A vacuum cleaner propelling unit comprising a first shaft transverse to the cleaner, a cleaner supporting roller at each end region of the first shaft, a pair of spaced frame members extending longitudinally in the cleaner, a second shaft rotatably supported in the frame members, a pair of drive rollers integral with the second shaft and normally disengaged from the cleaner supporting rollers, first and second concentric cylindrical surfaces formed within each supporting roller and spaced from each other a distance exceeding the diameter of the drive rollers, a pair of spaced levers of thin material flexible in torsion about their lengths, each lever supporting an end region of the first shaft at an intermediate region thereof and being pivoted at its lower end in a frame member, a handle, and a pivotal connection between the upper end region of each lever and the handle, whereby on pushing the handle longitudinally forward the drive rollers are engaged to the first cylindrical surfaces within the supporting rollers to propel the cleaner in the forward direction, on pulling the handle longitudinally backward the drive rollers are engaged to the second cylindrical surfaces within the cleaner supporting rollers to propel the cleaner in the rearward direction,

and on deflecting the handle laterally while pushing thereon one driving roller is engaged to the first cylindrical surface within one cooperating supporting roller to rotate the latter roller in the cleaner forward propelling direction while the other drive roller is engaged to the second cylindrical surface of the other supporting roller to rotate that supporting roller in the rearward direction, whereby the cleaner is propelled in a turn.

8. A vacuum cleaner propelling unit according to claim 7 in which each cleaner supporting roller is cup shaped with the open end facing inwardly of the cleaner, the motor means rotates the second shaft clockwise, the drive rollers on the second shaft are positioned within the supporting rollers and spaced from the first and second cylindrical surfaces thereof, and a pair of tension springs on opposite longitudinal sides of each lever, each spring having one end anchored in the upper end region of the lever and its other end anchored in the frame member to which the lever is pivoted.



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