

Aug. 30, 1966

HIROSHI FUKUBA
MANUAL FLOOR CLEANER WITH PIVOTALLY MOUNTED
RESILIENT DRIVING WHEELS

3,268,936

Filed Nov. 17, 1964

7 Sheets-Sheet 1

FIG. 7

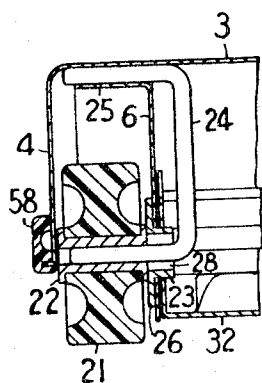
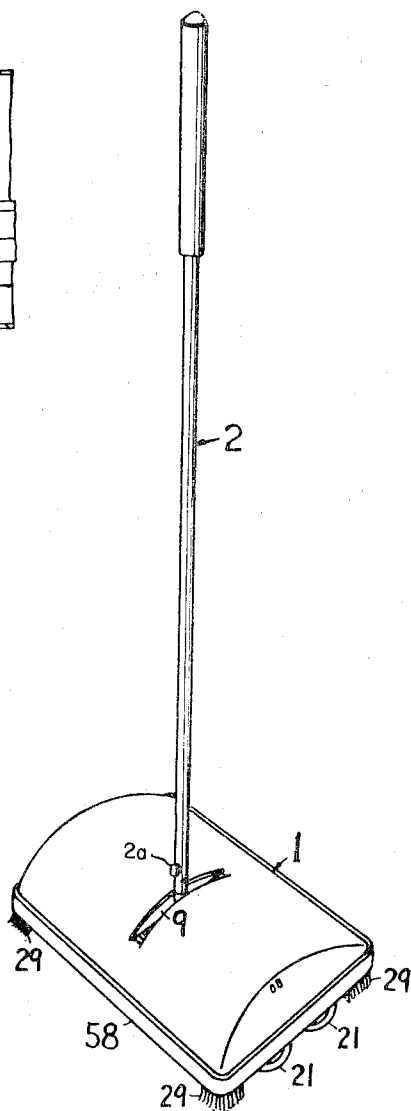


FIG. 1



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FIG. 2

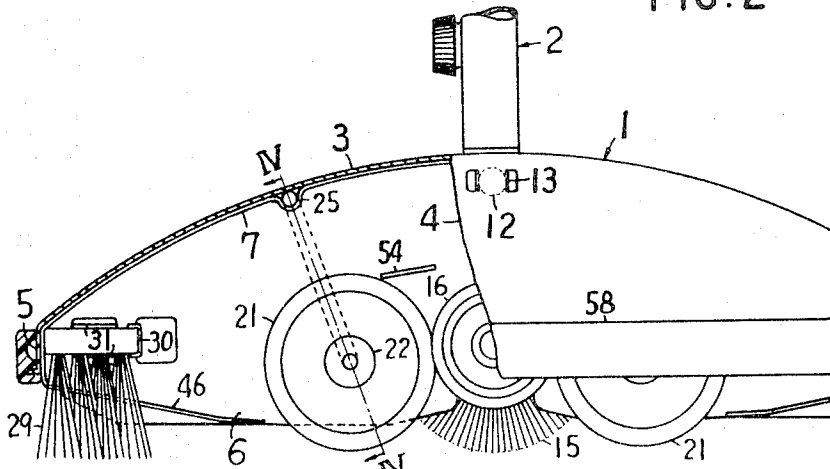
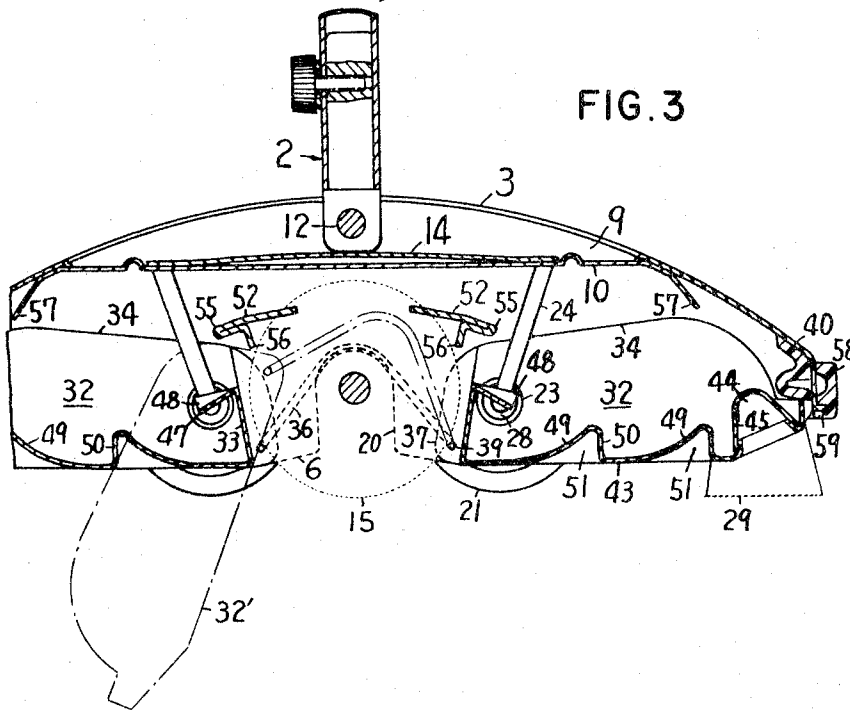


FIG. 3



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FIG. 4

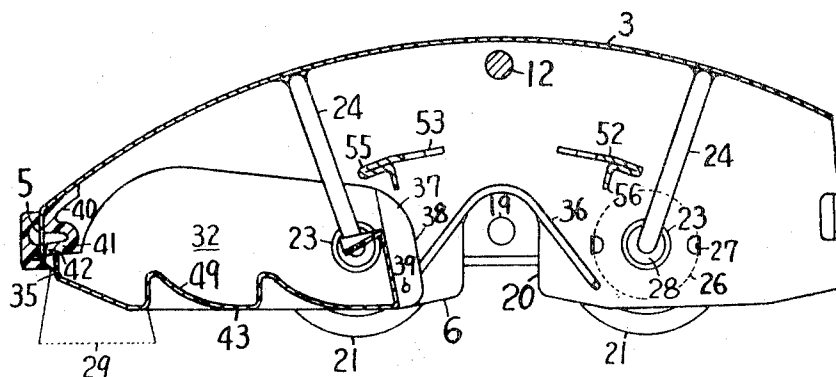
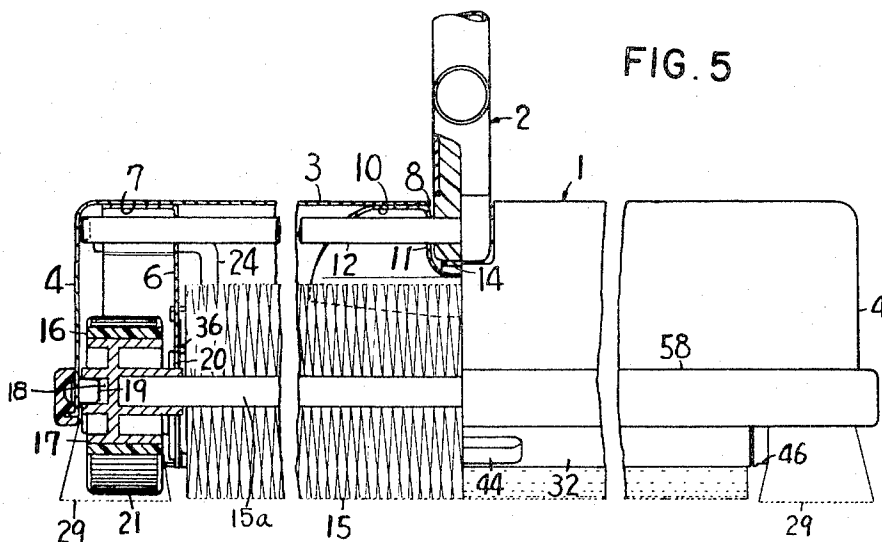


FIG. 5



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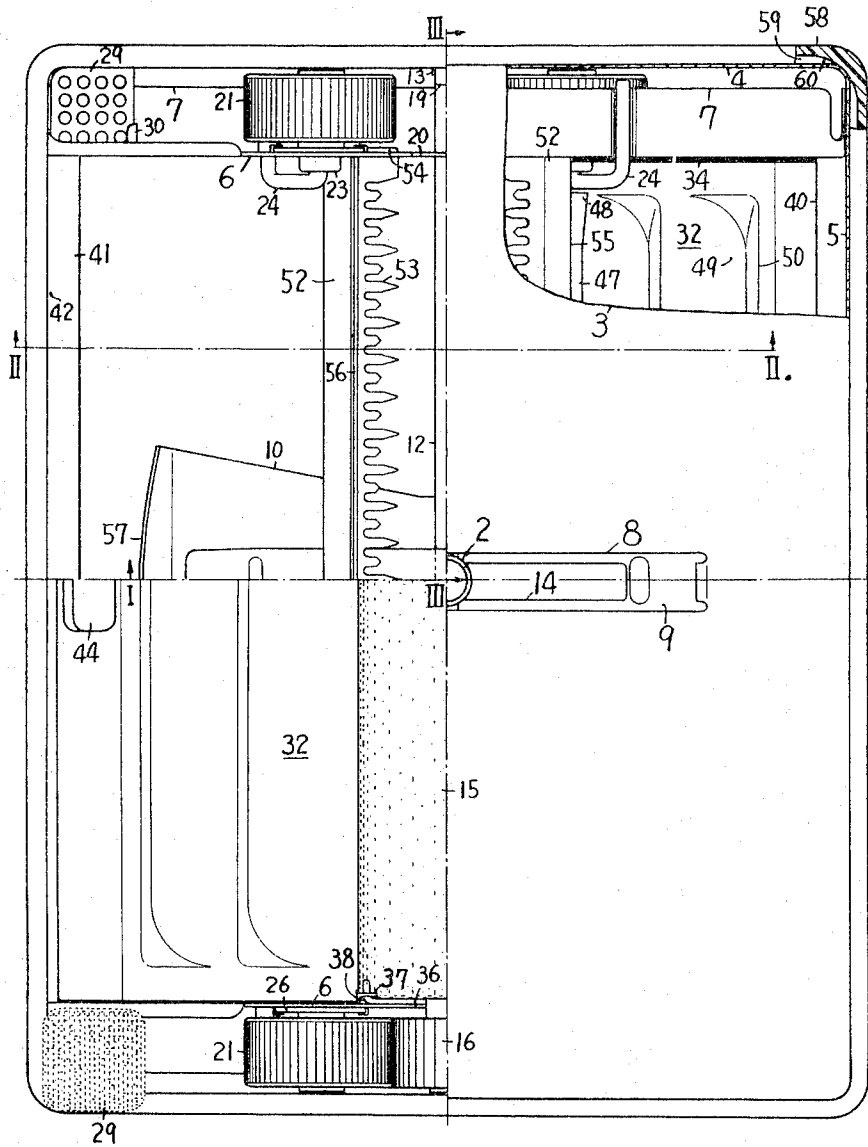
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FIG. 6



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FIG. 8

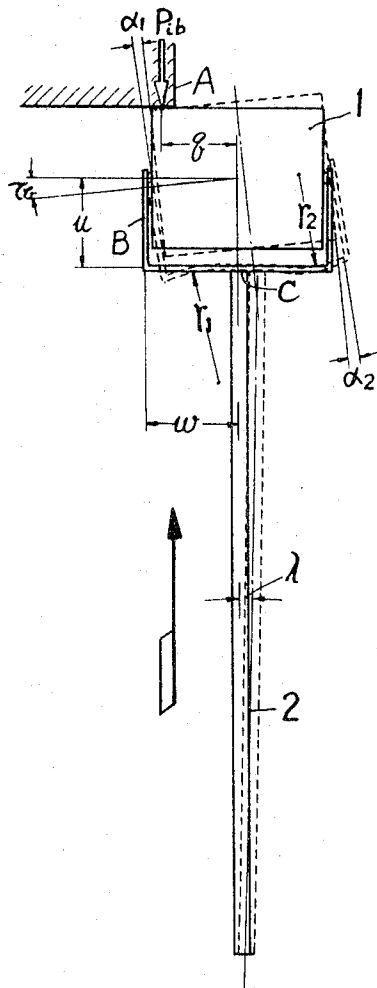
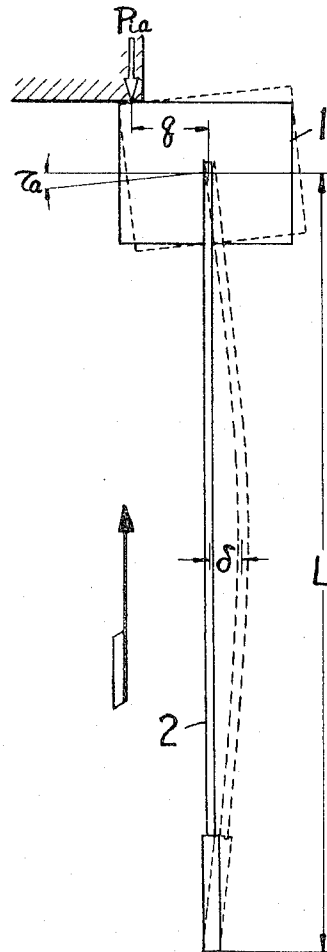


FIG. 9



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FIG. 10

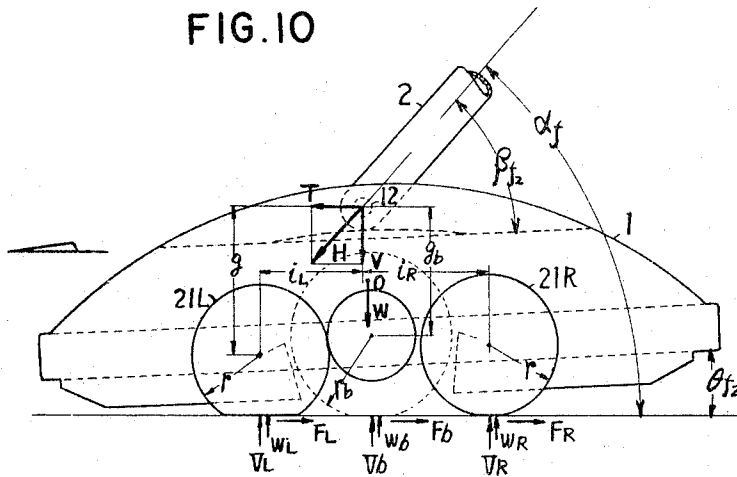
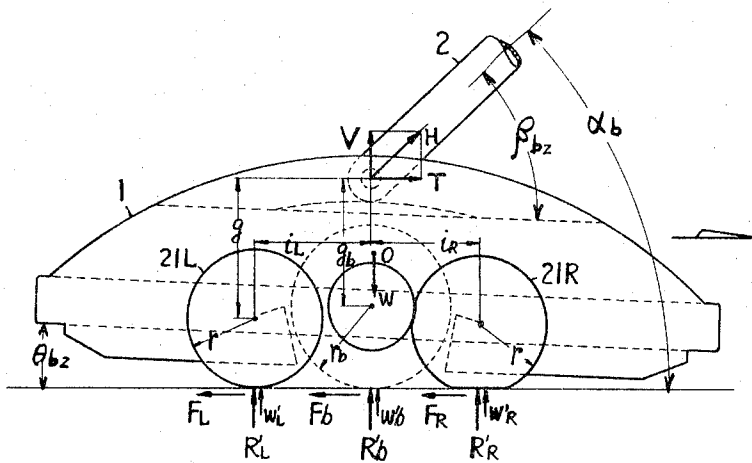


FIG. 11



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FIG. 12

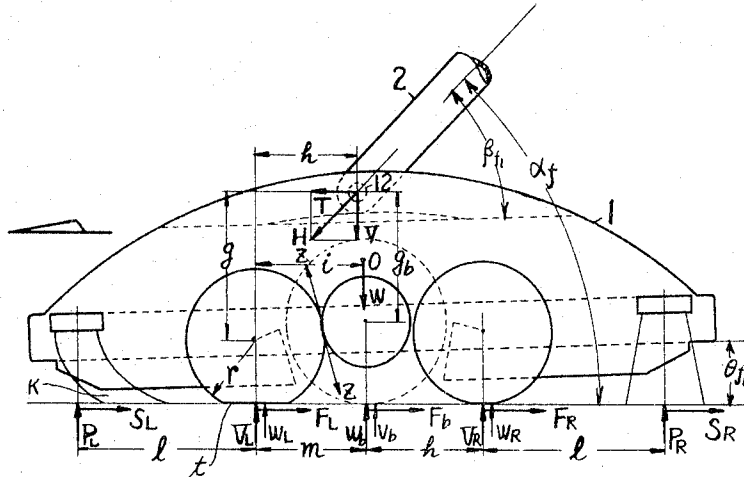
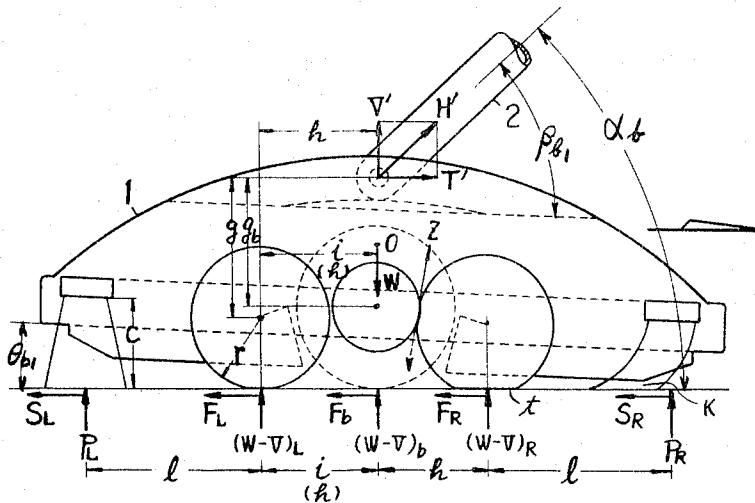


FIG. 13



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MANUAL FLOOR CLEANER WITH PIVOTALLY MOUNTED RESILIENT DRIVING WHEELS

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Filed Nov. 17, 1964, Ser. No. 411,838

2 Claims. (Cl. 15—41)

Floor cleaners have been known in the past which comprise rotary brushes provided in the frame lightly touching the floor surface for removing dust and dirt from the floor while the apparatus is moved manually forwards and backwards on the floor surface; driving wheels keeping contact with the floor surface during the aforementioned forwards and backwards movement of the apparatus for imparting rotation to said rotary brushes; and dust boxes being provided in the frame in front and back of said rotary brushes. These cleaners have not, however, been so designed as to lend themselves to operate on every kind of floor, such for example as concrete floors, boarded floors or carpeted floors.

Therefore, it is the general object of the invention to overcome the foregoing and other deficiencies and objections to prior art practices by the provision of a manual cleaner, which is small in size and light in weight, but is extremely efficient in operation and simple in construction.

A further object of the invention is the provision in a manual sweeper of driving wheels adapted to impart rotation to a rotary brush mounted transversely in the center of the main casing which driving wheels are mounted on both sides of driven wheels connected to the brush, and wherein the driving wheels are pivotally mounted with respect to the casing with the result that these wheels oscillate to allow those wheels on only one side of the brush to provide a friction contact with the driven wheels of the brush dependent upon the direction of movement of the cleaner, and further which driving wheels are made of rubber or the like material which is pliable and resilient to further facilitate the contacting thereof with the driven wheel, and to allow tilting of the cleaner casing thereby facilitating picking up of large objects with the brush. This feature also insures a positive brushing contact with any floor surface, such as piled carpets, concrete, or vinyl tile.

Another object of the invention is to incorporate uniquely mounted and positioned dust catching boxes which greatly facilitate the collection of the dust picked up by the brush, and which may be easily opened for discharge of the contents therein.

A further object of the invention is to make the sides of the casing from resilient metal so that the sides may be manually spread apart to allow positioning or removal of the brush in rotatable mounted relationship therewith.

These and other features of this invention will be clearly understood when considered with reference to the accompanying drawings wherein:

FIG. 1 is a perspective view of a cleaner of this invention;

FIG. 2 is a side view of the cleaner, with part of the side plate of the main casing being cut away;

FIG. 3 is a longitudinal section taken along the line I—I of FIG. 6;

FIG. 4 is a longitudinal section taken along the line II—II of FIG. 6 with the dust box on the right hand side being removed for clarity;

FIG. 5 is a front view of the apparatus with a part shown in section taken along the line III—III of FIG. 6;

FIG. 6 is a plan view of the apparatus, the right half thereof being a view as seen from above with a part of the outer cover plate being removed and the left half thereof being a view as seen from below with the upper

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half of said left half portion being shown without a dust box and a rotary brush;

FIG. 7 is a section taken along the line IV—IV of FIG. 2;

FIG. 8 is a plan view showing the manner in which a cleaner of the conventional type strikes at the corner of walls in operation;

FIG. 9 is a plan view showing the manner in which a cleaner of this invention strikes at the corner of walls in operation;

FIGS. 10 and 11 are views showing the way in which a cleaner of this invention having no corner brushes is operated, with FIG. 10 showing a cleaner being pushed in the forward direction and FIG. 11 showing the same being pulled back in the rearward direction; and

FIGS. 12 and 13 are views showing the way in which a cleaner of this invention having corner brushes is operated, with FIG. 12 showing a cleaner being pushed in the forward direction and FIG. 13 showing the same being pulled back in the rearward direction.

The invention will now be explained with reference to an embodiment illustrated in the accompanying drawings. The cleaner of this invention as shown in FIG. 1 comprises an apparatus which includes main casing 1 made of thin sheet metal which is rectangular in plan and arcuate in side view and an elongated stem 2 mounted in the center on the top of the apparatus casing for manual operation of the cleaner in a standing posture. Vertical side plates 4, 4 which constitute both sides of the main casing and vertical skirts 5, 5 which are extensions of the front and rear ends of the outer cover plate 3 which has an arcuate section form integral with said outer cover plate 3, the main casing of thin sheet metal. Inside of said main casing are partition plates 6, 6 parallel to said side plates 4, 4 with a slight distance between them. Said partition plates are made of thin sheet metal and the tops of these metal sheets have bent edges and are arcuated just the same as the arc line of said outer cover plate so that said bent edges are attached to the under side of said cover plate by being spot-welded together. In the center of outer cover plate 3 is an elongated slot 8 extending in the direction of movement of the apparatus. On the underside of said slot an auxiliary plate 10 of thin sheet metal, in which is formed a recess 9 which receives therein the lower end of said stem 2 is mounted by spot welding. The outer cover plate 3, having an arcuate section, is rigid enough to withstand several external forces and is easy to produce.

It will be appreciated that, if a stem for operating the cleaner is directly mounted on some part of the main casing, said particular part is liable to be damaged and broken, and that, even if a stub shaft or a reinforcing plate were used in said part, the result would be the same.

In the cleaner of this invention, a slightly big shaft 12 made of metal or other material of the same stoutness and having a length sufficient to cover the distance between the two side plates 4, 4 is positioned closely below the outer cover plate 3 and extends through walls 11, 11 forming said recess 9 as well as through both partition plates 6, 6. Both ends of said shaft 12 are held so firmly by members 13, 13 which are small parts of side plates 4 being partially cut and set upright, that said shaft 12 may not rattle in the main casing. The central portion of said shaft 12 which passes through said recess 9, also passes through a bearing hole bored in a short steel cup to which the end of aforementioned long stem 2 is fast connected. Thus the stem 2 and the main casing are securely connected with one another. The recess 9 has a depth and a width sufficient to accommodate the stem 2 lying horizontally in such a manner that the surface of said stem does not appear out of the plane of the upper surface of the main casing. Mounted at the base of said recess is a plate spring 14

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which is slightly raised in the middle. The lower end of stem 2 makes resilient contact with the plate so that said stem may be held firmly in a vertical position with respect to the cleaner.

The value of secondary moment of the section of the stem 2 has been made as small as is suitable taking into consideration the weight and breadth of cleaner and the irregularities on the floor, to convert the vibration arising therefrom into a small flexuous vibration and absorb said vibration, so that the operator does not feel unpleasant vibration and can perform work in a pleasant mood.

It is desirable that the elongated stem 2 be easily removable from the main casing 1. For this purpose, a construction is adopted in which, as seen in FIG. 3, the lower end of stem 2, which is made of a thin pipe, receives a stub which is mounted on the shaft 12. Said stub and hollow steel stem are connected fast with one another by means of a set-screw 2a.

The rotary brush 15 for sweeping the floor, which is mounted transversely of the main casing at right angles to the direction of movement of the apparatus in the center of the apparatus between the two partition plates 6, 6, is provided with driven wheels 16 at both ends of its shaft 15a. Each of said driven wheels is disposed between said partition plate 6 and side plate 4, and comprises a tire made from rubber or a like substance which is not pliable. Each driven wheel is fitted around a hub 17 made of nylon which is mounted on the end of the shaft 15a of the brush 15. Preferably the surface of said tire 16 of driven wheel is knurled since rotation is transmitted by the driving wheel with which it is kept in contact as will subsequently be described. There is provided in the center of end of the face of said hub 17 a shaft hole 18 (see FIG. 5) in which is mounted the stub shaft 19 which in turn is firmly secured to the lower part of side plate 4 so that the stub shaft 19 rotatably supports a rotary brush 15. This arrangement facilitates replacements and adjustments of the rotary brush 15 for, when it is desired to remove said rotary brush from the main casing, pushing outwardly and opening the side plate 4 followed by pulling out the stub shaft 19 from the shaft hole 18 thus finishes the job. In order to further facilitate mounting and removing the rotary brush, a slot 20 having a lower open end as seen in FIG. 4 is provided in the portion of partition plate 6 through which the shaft of rotary brush 15 passes. Each of the driving wheels 21, which are disposed in front and in back of a driven wheel for engagement with and imparting rotation to said driven wheel, is journaled in a bearing sleeve 22 made of nylon. The bearing sleeve is carried by the support shaft 24 which passes through the short annular piece 23 carried by the partition plate 6 and is bent obliquely upwards along the partition wall (see FIG. 7). The support shaft 24 has the upper end thereof further bent toward the side plate 4 and received in the groove 25 formed in the flange 7 of the upper part of partition 6. The outer cover plate 3 keeps contact with said upper end of support shaft 24 in order to prevent it from becoming rickety. The short annular piece 23 has a wide collar 26 on that side of partition plate 6 on which the driving wheel 21 is mounted, said collar being secured to the partition wall 6 by means of claws 27 formed integral with the partition plate 6 at several positions (see FIGS. 4 and 6). The inner diameter of the hole of annular piece 23 is larger than the diameter of support shaft 24 as seen in FIGS. 3, 4 and 7 so that said support shaft 24 can oscillate in said hole 28 with said groove 25 as a pivot. This oscillatory movement is such that when the cleaner is moved to the left as seen in FIG. 12 the driving wheel on the left side is caused to contact the driven wheel 16 by the pressure of contact with the floor surface, while on the contrary when the cleaner is moved to the right as seen in FIG. 13, the driving wheel 21 on the right side contacts with the driven wheel 16, with the driving wheel on the left disengaging itself from the driven wheel 16. As this operation is carried out, forward and backward movement

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of the cleaner takes place smoothly. The driving wheel 21, made of rubber or like substance which is pliable and resilient, is knurled so that the friction with the floor surface and the driven wheel is increased. This pliability of the material causes the wheel to be easily deformed when the cleaner is operated on carpets having thick pile so that damage to carpets may be prevented. Said pliability also makes it possible, when the driving wheel contacts the driven wheel, to release the shearing force applied to the journal part of the latter, thereby preventing damage to the apparatus.

There are provided in four corners of the apparatus at the front and rear ends between side plate 4 and partition plate 6 brushes 29, 29 which have the bristles thereof keeping touch with the floor surface. Each of said brushes is supported by the stop member 30 and 31 (see FIG. 2) formed integral with the partition plate 6.

As the cleaner of this invention has been designed to be light in weight, its weight W is substantially smaller than that of conventional cleaners. In order to achieve a high efficiency in transmitting power from the driving wheel 21 to the driven wheel 16 and a smooth performance of the cleaner, the center of rotation of the driving wheel 21 must be lower than the center of rotation of the rotary brush as shown in FIG. 2. If the center of rotation of the driving wheel 21 is higher than that of the driven wheel 16, there will not be enough contact pressure and the wheels are liable to slip. The best size of a driving wheel 21 relative to the driven wheel 16 has been determined after several experiments as shown in FIG. 2.

The stem 2 is directly mounted in the center of the upper surface of main casing 1. As a result of this, the stem support shaft 12 on which the stem 2 is pivoted is mounted above the center line of the rotary brush 15. As the size of the driving wheel is restricted as described above, the distance g between the center of rotation of the driving wheel 21 and the center of the stem support shaft 12 is necessarily substantially large.

The relative positions of the corner brushes 29 are such that the corner brushes on the side opposite to the direction of movement of the cleaner, i.e. the right side brushes 29 as seen in FIG. 12 and left side brushes 29 as seen in FIG. 13, slide on floor surface with a slight contact pressure as shown in these drawings. These brushes serve as a shock absorber, and in addition, because they are positioned in the four corners of the main frame, it is possible to sweep every nook and corner of a room.

The horizontal distances 1 and 1' between the center of driving wheels 21, 21 and the corner brushes 29, 29 can be made considerably large as compared with the vertical distances r, r' between the center of rotation of driving wheels 21, 21 and the floor surface. Therefore, moments to turn the main casing can come into balance easily and it is possible to operate the apparatus smoothly and clean every corner of the room with very little resistance being offered.

Driving wheels 21 are in a somewhat deformed state as indicated by a symbol t in FIGS. 12 and 13 when they are actuated because the material from which they are made is rather low in rigidity. Consequently, the area in which they keep contact with the floor surface is comparatively large eliminating the danger of slipping and damaging the floor to be swept cleaner. The amount of driving wheel to be deformed t is proportional to the load on the contact point which is mainly transmitted through the stem 2.

In sweeping up nails and pins scattered on hard and flat floors, such as concrete floors or boarded floors, the size of clearance between the lower end of front wall of the dust box and the floor surface poses a problem difficult to solve. If this clearance k were too large, such pins and nails would be sent flying in the direction of movement of the apparatus along the floor surface. In the cleaner of this invention, however, a slight increase

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in the pressure brought to bear upon the stem 2 makes the amount of deformation t larger and the clearance k smaller, so that the aforementioned disadvantage can be eliminated and the floor is swept clean of nails and pins. When there are small projections on the floor, a momentary increase in the amount of deformation of the wheel t when said wheel rides over such projections will cause no appreciable change in the clearance k , thereby contributing to the maintenance of excellent operational performance of the cleaner.

The dust boxes 32 for receiving therein the dust and dirt swept up from the floor have inlet ports 33 disposed in front and in back of said rotary brush 15. The opposite side walls 34, 34 of each dust box 32 is located adjacent the partition plates 6, 6, the former being carried by the support shaft 23 which is mounted on said partition plate 6, 6 so that each dust box 32 may be operatively pivotable, with the outer end edge 35 of said dust box being movable downwards. A rod spring 36 urging the outer end edge 35 of dust box upwards is provided as shown in FIGS. 3 and 5. The front end of said spring 36 is inserted in the recess 38 formed between the side plate 34 and the partition plate 6 by inwardly bending the internal end edge 37 of said side plate 34. The central portion of said spring 36 is disposed along the slot 20 above said slot, one end of said spring 36 being bent and received in the hole 39 provided below said inner edge 37 and the other end being received in like manner in the hole 39 provided in the other dust box 32. The upper part of outer end edge 35 of dust box bears against the lower edge of the packing 40, mounted inside the skirt portion of the outer cover plate 3, by the biasing force of the spring 36. As seen in FIGS. 3 and 4, the lower portion 41 of said packing 40 is curved and its free end 42 is oscillatable and extends along the inner side of skirt plate 5, said free end receiving the upper part of the end edge 35 of dust box. In this way, the lower portion 41 of packing is normally pressed against the end edge 35 of dust box which oscillates during cleaning operation, thereby preventing said end edge 35 from being dislodged to spill the dust collected. The recess 44 provided in the box base 43 as shown in FIG. 3 is for sticking the finger inside the box to dislodge the end edge 35 for opening the dust box 32. The position of said spring 36 relative to the dust box is such that the dust box takes a position as shown in a dotted line 32' in FIG. 3 when the degree of opening exceeds a predetermined limit. The side plate 34 of dust box being disposed adjacent the partition plate 6 as above described, there is a tendency for those bristles of a corner brush 29 which are near the partition plate 6 to be dragged in between side plate 34 and partition plate 6 when the dust box is closed from the open position. In order to prevent this tendency, the lower part of the partition plate 6 is curved slightly toward the brush 29 (see FIGS. 2, 5 and 6) so that that portion of bristles which is near the partition plate may be turned away from the partition plate. As seen in FIG. 3, the edge of inlet port 33 of dust box 32 rises from the base plate 43 along the rotary brush 15, with the upper edge thereof being slightly bent toward the box 32 at the middle section. This bent edge 47 prevents the light dust, such as cotton waste that has been swept into the dust box, from being drawn out of said dust box by the rotary brush 15 that might contact said dust during the movement of the cleaner. And the opposite ends 48 of this bent edge 47 hold in place the support shaft 24 of said driving wheel 21 that tends to slip out into the dust box 32. The bottom 43 of dust box comprises a plurality of raised and depressed area formed to provide, as seen in FIGS. 3, 4 and 6, an inclined surface 49 that rises gently from the front to the rear and a vertical surface 50 that drops sharply from the summit of said inclined surface. The bottom also has on its underside a plurality of grooves 51. The relatively heavy dust swept into the dust box 32 and collected on the bottom 43 will easily climb over the arcuate portion 49 but not the vertical wall 50 as it

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moves on said bottom when the cleaner is moved backwards and forwards, so that the dust on said bottom gradually moves toward the outer edge without being spilled from the inlet port 33. Discharge of dust collected in the dust box is achieved when the dust box 32 is opened by rotating the end edge 35.

As the cleaner is moved forwards and backwards, air is vigorously blown up from the bottom of the apparatus by the rotation of rotary brush 15. Such air contains minute dust which flies high in the room, creating an unsanitary atmosphere. As, however, the bottom 43 of the dust box of the cleaner of this invention is provided with raised and depressed area 44 that have grooves 51 on the underside thereof, the current of air produced under the apparatus is expanded, disturbed and has its course changed, so that it gradually loses its power. Thus the above-mentioned disadvantage is eliminated. It is possible, therefore, in the case of the cleaner of this invention to mount a dust box 32 on the apparatus with the bottom 43 of said dust box closely adjacent the floor surface. With this arrangement, the solids like cigarette butts that have been caught between bottom 43 and floor surface are ultimately swept into the dust box without being flipped out of the apparatus, with the operational efficiency of the rotary brush 15 being increased greatly.

Cleaning bars 52 are provided above the rotary brush 15, on both sides thereof for scraping off the dust that has become adhered to the rotary brush in order to insure that the dust swept up by said rotary brush is positively transferred into the dust box. As shown in FIG. 6 each of the cleaning bars 52 is formed to provide a front edge 53 shaped in the form of the teeth of a comb, said front edge 53 engaging the bristles of the rotary brush 15 and the end portions thereof being received by the partition plates 6, 6 on the right and left. As seen in FIGS. 3 and 4, the cleaning bar 52 is made of a thin sheet metal and comprises a rear edge 55 projecting above the inlet port 33 of the dust box 32 and bent back along the undersurface halfway, the lower end portion 56 being bent again downwards to come into contact with the bristles of the rotary brush 15. This arrangement ensures that when the rotary brush 15 rotates clockwise in FIG. 3 the lower end portion 56 of the left side cleaning bar 52 scrapes off the dust that has become adhered to the bristles of the rotary brush 15 so that it may drop into the left side dust box. The dust that has escaped this scraping operation passes through the comb-shaped portion immediately above it and is scraped off and removed by the comb-shaped portion of the right side cleaning bar 52. When the rotary brush 15 rotates counter-clockwise, the lower end portion 56 of the right side cleaning bar 52 and the comb-shaped portion 53 of the left side cleaning bar 52 scrape off and remove dust that has become adhered to the bristles of the rotary brush 15. Thus the light dust like cotton waste scraped off by the comb-shaped portions 53, 53 drops from the rear edge 53 of cleaning bar 52 into the dust box 32 and is retained therein. Such dust will float in the dust box as the cleaner reciprocates and grow into large masses which have a tendency to be attracted by the rotary brush 15. When such masses of cotton waste come into contact with the rotating brush 15, they might be caught by the bristles and drawn out of the dust box to be scattered on the floor. As, however, the rear edge 55 of said cleaning bar 52 projects above the inlet port 33, this construction serves to prevent said masses of dust from dropping off the dust box.

If light dust such as the cotton waste as aforementioned floats in the dust box, it will eventually be caught by the bristles of the rotating brush 15 during the cleaning operation. It is a very important function of a cleaner to prevent this from happening. For this purpose, the front and rear end portions 57, 57 of the accessory plate 10 attached to the underside of the outer cover plate 3 are formed to provide a wide edge which projects toward the rear edge 35 of the dust box (see FIGS. 3-6). Thus, the bent edge 47 of the upper edge of an inlet port, the

rear edge of a cleaning bar, and the front and rear edges 57 of the accessory plate, while offering no obstacles to the dust sweep in operation of the rotary brush 15, prevent the masses of light dust that have already been swept in from moving toward the rotary brush 15.

During the operation on the floor, the cleaner will often strike some objects placed on said floor as well as the walls and pillars. In order to prevent the cleaner and the objects to which it strikes at from being damaged by the impact of such collision, a bumper 58 is provided around all four sides of the cleaner casing at the lower portion of the skirt 5 and side plates 4, 4, said bumper 58 being received on the edge 59 which has the lower portion thereof bent outwardly. Said receiving edge 59, which is simply means to support the bumper 58, will eat into the bumper in the front end thereof when the cleaner strikes at some object during the cleaning operation. But the damage to this portion will be relatively slight when the impact occurs to the linear portion along the front and rear edges or the side edges of the main casing.

The receiving edge 59 is formed to provide an arcuate edge 60 which is on the same plane as the skirt 5 in each of the four corners of the main casing as seen in the right upper corner in FIG. 6.

While the foregoing illustrations and descriptions are set forth about a preferred embodiment of the invention, the same is, of course, subject to modification without departing from the spirit and scope of the invention.

What I claim is:

1. In a floor cleaner, the combination of
a main casing having a recessed bottom portion with the casing being substantially rectangular in plan and of convex arcuate shape in side elevation with the two short sides being resiliently bendable manually outwardly,
elongated resilient and deformable brush means rotatably mounted at each end to the short sides of the casing inside the recessed bottom portion whereby the brush means is substantially parallel to the bottom of the casing and extends below the bottom surface thereof, and whereby the brush means may be removed by manually bending the short sides outwardly,
substantially rigid driven rollers of lesser diameter than the brush means operatively mounted in fixed relation to each end of the brush means,
four substantially U-shaped support shafts, each respective shaft having one leg pivotally mounted to the inside of the main casing substantially parallel to the brush means and in alignment on one side or the other of one of the driven rollers, the central por-

tion of each shaft directed downwardly and inwardly axially of the cleaner toward its respective side of one of the driven rollers,

means to limit the pivotal movement of the other leg of each shaft around the pivotally mounted leg so as to allow limited oscillatory movement thereof, four resilient driving rollers each rotatably mounted to the other leg of a respective shaft so as to be on each side of the driven rollers in alignment therewith and normally slightly out of contact with the driven rollers, said driving rollers center of rotation being slightly below the axis of the brush means, but said brush means extending slightly below the bottom of said driving rollers,

means to collect dust and dirt particles picked up by the brush means, and

means to manually push the main casing over a floor to pivotally move at least certain of the driving rollers into frictional contact with the driven rollers to effect rotation of said brush means and cleaning of the floor.

2. A floor cleaner according to claim 1 wherein partition plates are secured in the recessed bottom portion of the main casing to define a rotary brush section and a rotary brush driving section, and where the short sides of the outer cover are resilient and manually bendable outwardly, a stub shaft centrally mounted on each of the short sides and directed inwardly to rotatably mount each end of the brush means.

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