Oct. 29, 1968 L. L. OTTO ET AL 3,407,422

BRUSH ATTACHMENT FOR FLOOR MACHINE

Filed July 27, 1966 2 Sheets-Sheet 1

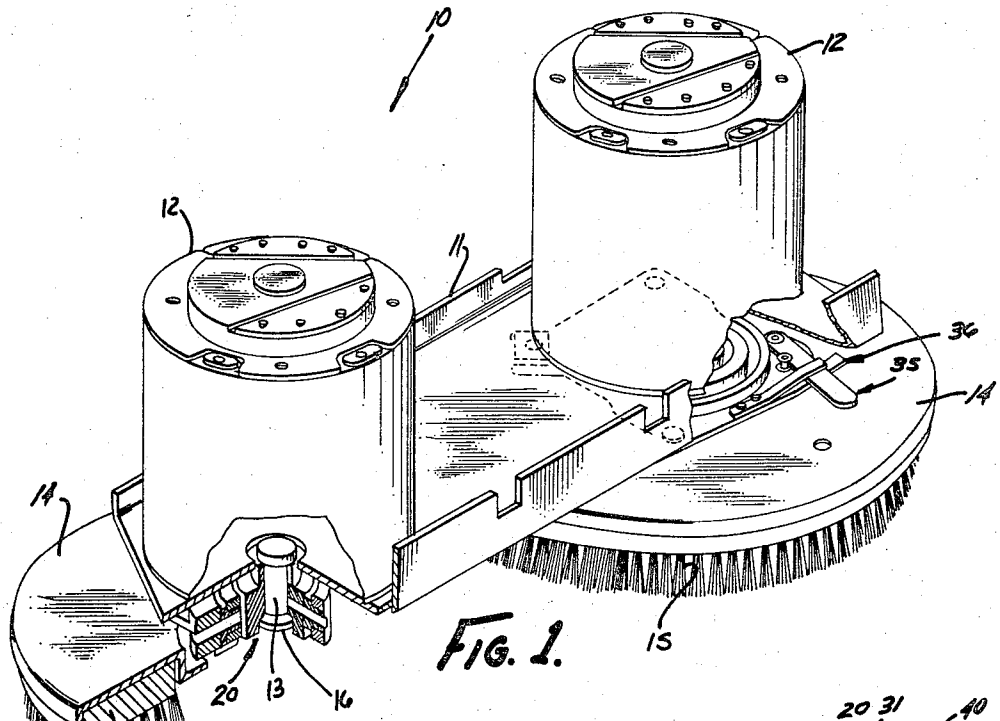



FIG. 1.

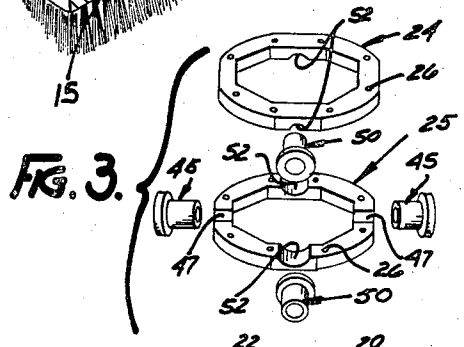



FIG. 3.

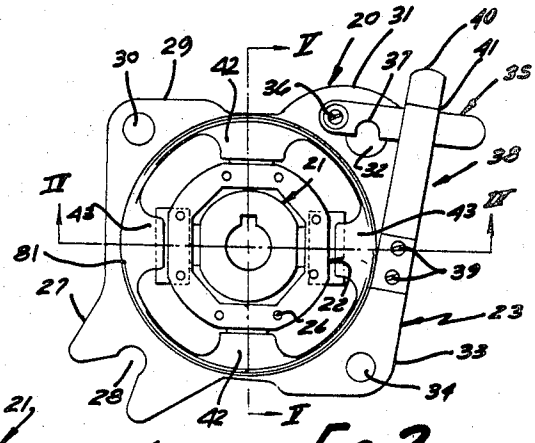



FIG. 2.

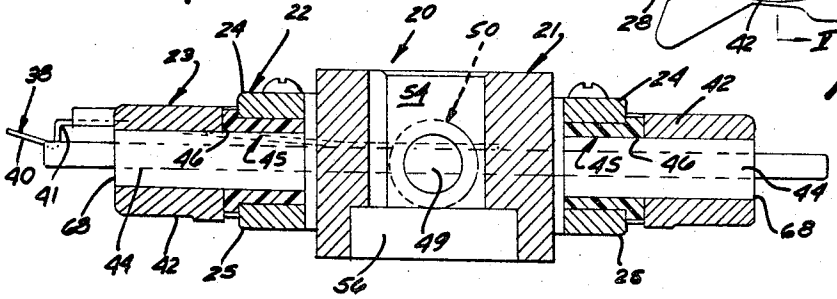



FIG 5.

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BRUSH ATTACHMENT FOR FLOOR MACHINE

Filed July 27, 1966 2 Sheets-Sheet 2

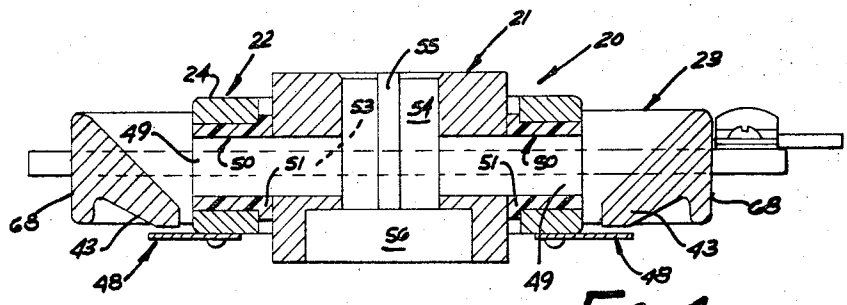



FIG. 4.

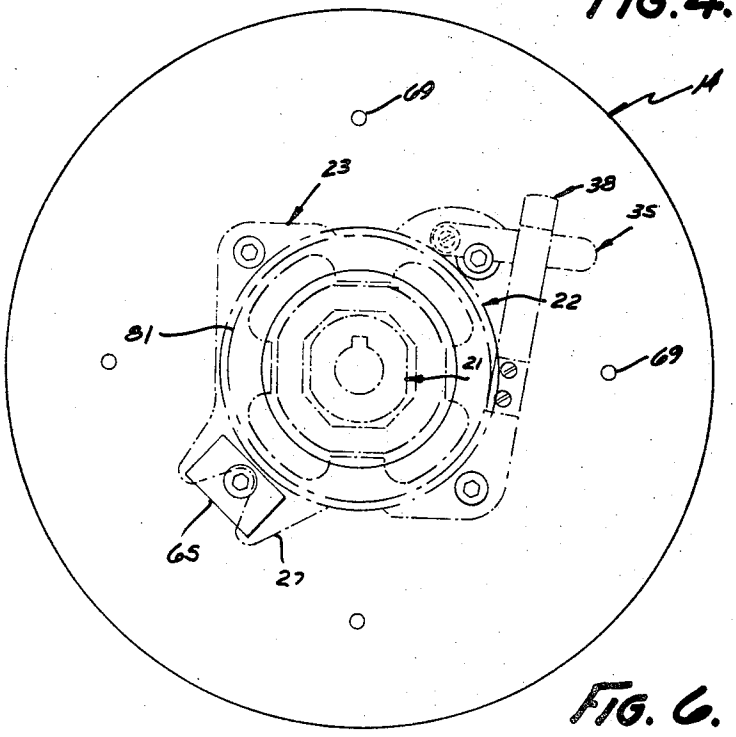



FIG. 6.

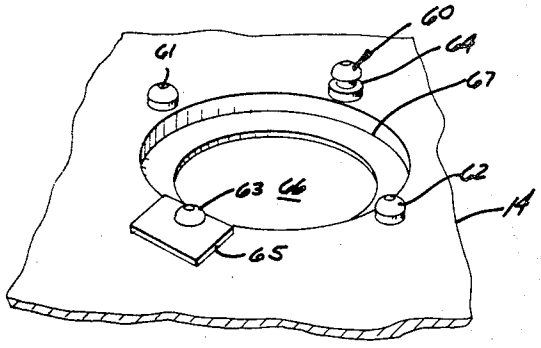



FIG. 7.

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3,407,422

# BRUSH ATTACHMENT FOR FLOOR MACHINE

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11 Claims. (Cl. 15—49)

## ABSTRACT OF THE DISCLOSURE

A brush-motor coupling apparatus for utilization on floor treatment brushes and the like having two gimbals connected to a brush-mating housing in such a manner that, when the shaft of the motor is affixed to the inner gimbal, the housing is free to pivot about two coordinate axes with respect to the shaft in gimbal-like fashion. The housing is affixed to the brush by a series of upstanding members on the brush-backing plate which are received in suitable apertures in the housing, a latch lever being provided for securing the assembly together.

This invention relates to floor treating machines and, more particularly, to a brush attachment mechanism adaptable for utilization on machines designed to perform scrubbing, waxing and similar floor treatment operations.

Mechanical floor scrubbers and waxers have been well-known in the art for a long period of time. Basically, these machines consist of some type of prime mover, usually an electric motor, which is rotatably attached to a floor implement such as a brush or buffing pad. Means are provided for restricting the rotation of the prime mover and, thus, allowing the floor implement to rotate with respect to the floor. Usually, these restraining means take the form of a handle attached to the motor and extending upwardly therefrom such that it may be grasped by the operator. By manipulating this handle, the operator may guide the unit to desired sections of the floor being treated. If a conventional, high-speed, electric motor is utilized in the unit, it is necessary that some type of gear reduction means be incorporated to reduce the speed of rotation of the floor implement. Motors are available, however, which produce sufficient torque at desirable operating speeds to permit the elimination of this gear-reduction train.

Because all floors are not absolutely level, units of the type described above preferably incorporate some type of coupling device which permits the axis of rotation of the floor implement to shift angularly with respect to the axis of rotation of the driving motor. In other words, the floor contact tool has limited freedom of angular "float." Such mounting permits the center of gravity of the machine to stay directly over the axis of rotation of the brush unit within reasonable limits. This eliminates eccentric loading of the brush and the consequent tendency of the machine to "grab" the floor and pull the unit from the operator. Such a coupling finds additional utility where more than one unit is affixed to a framework provided with only one handle. In the latter case, where two or more implements are rotating side-by-side, it would be impossible for the units to adapt to varying contours in the floor without such mounting devices. Additionally, coupling devices of this type markedly reduce the strain and wear placed on the bearings of the apparatus. This is particularly true where a low-speed, high-torque motor is being utilized to drive the floor element directly. The relatively limited bearing areas available in the motor itself require that side torques be minimized to provide satisfactory motor life.

Finally, such units as described above incorporate some type of means which allows removal and replacement of the individual floor elements. This, of course, allows the



utilization of the same unit for scrubbing, buffing and other types of operations and additionally allows replacement of worn floor implements. Ideally, these means allow renewal and replacement of the floor implements with relative ease while positively securing them to the unit during usage.

It is an object of this invention to provide a novel floor treating unit of the type described.

More particularly, it is an object of this invention to provide a floor treating unit where in the axis of rotation of the floor treating implement may shift angularly with respect to the axis of rotation of the motor and, yet, the brush is always smoothly and positively rotatably connected to the prime mover.

It is an object of this invention to provide a device of the type described wherein the point of gravity force application of the unit always remains directly over the axis of rotation of the floor implement, thus eliminating the tendency for one peripheral section of the floor implement to "grab" and cause the operator to loose control of the machine.

It is an object of this invention to provide a connection between the prime mover and the floor implement which allows a plurality of units to be mounted on the same frame in side-by-side relationship without fear of missing certain sections of the floor or losing control of the machine because of uneven surface contours.

It is an object of this invention to provide a direct drive coupling device wherein motor side torques which result in premature motor failure are minimized.

It is an object of this invention to provide a device of the type described wherein the floor implement follows closely all major floor level imperfections so as to insure proper treatment of all segments of the floor.

It is yet another object of this invention to provide an apparatus of the type described embodying a novel means whereby the floor implement may be attached to and removed from the unit with relative ease, thus permitting prompt replacement and renewal thereof.

These, as well as other objects of this invention will be clearly understood by reference to the following specification and accompanying figures in which:

FIG. 1 is a fragmentary perspective view, partially in cross section, showing a tandem arrangement of floor treating units, each of which embodies the principles of this invention;

FIG. 2 is a plan view of the gimbal structure which rotatably connects the drive motors to their respective floor implements;

FIG. 3 is an exploded perspective view of the sectionalized outer gimbal and the bearings which are mounted therein;

FIG. 4 is a cross sectional view taken along line IV—IV of FIG. 2;

FIG. 5 is a cross sectional view taken along line V—V of FIG. 2;

FIG. 6 is a plan view of the implement plate showing, in phantom lines, the gimbal structure affixed thereto; and

FIG. 7 is a fragmentary, perspective view of the gimbal structure receiving section of the implement plate.

Briefly, this invention comprises an apparatus for rotatably affixing an implement retaining plate to a motor having a shaft extending therefrom. The apparatus includes a gimbal structure having a housing, an outer gimbal pivotably mounted within the housing for pivotable movement about one coordinate axis and an inner gimbal mounted within the outer gimbal for pivotable movement about another coordinate axis. The outer gimbal is sectionalized or split to permit easy assembly of the structure.

Means are provided for affixing the motor shaft to

the inner gimbal and for affixing the gimbal housing to the gimbal plate. The later means preferably includes a plurality of apertures in the gimbal housing and a plurality of upstanding members on the implement plate adapted to be received by the apertures. Means are provided for selectively retaining these members within their respective apertures and, thus, retaining the implement plate to the floor treating unit. In this manner, the anchor or retaining mechanism is freed of the necessity of transmitting torque from the shaft to the floor tool.

Referring now to the figures, a preferred embodiment of this invention will be described in detail. FIG. 1 shows a tandem floor treating unit **10** having a common frame **11** on which are positioned a pair of electric motors **12**. Motors **12** are preferably of the low-speed, permanent-magnet type so as to provide high torque at relatively low r.p.m. and, thus, permit direct coupling of the shafts **13** to the floor implement. Implement mounting plates **14** are rotatably affixed to each of the shafts **13** by means of gimbal structures **20** to be described hereinafter. Suitable key means (not shown) and a cap **16** may be utilized to connect the gimbal structure **20** to the shaft **13** since this connection is relatively permanent. As shown, implement mounting plates **14** each have circular brushes **15** affixed thereto. It will be readily appreciated by those skilled in the art, however, that the concepts set forth in this invention markedly increase the adaptability of the unit for any type of floor treatment operation. It will be apparent, also, to those skilled in the art that while FIG. 1 shows a tandem treatment unit, the concepts set forth herein apply equally to single units, i.e., units embodying only one motor and one floor implement. In the apparatus shown in FIG. 1, one handle would usually be provided for control by a single operator. In the event only a single unit was desired, the size of the frame **11** would be reduced and the handle affixed directly to it.

Referring now to FIGS. 2, 3, 4 and 5, there is shown the gimbal structure **20** which comprises an inner gimbal **21**, an outer gimbal **22** and a gimbal housing **23**. As shown best in FIG. 3, outer gimbal **22** preferably comprises upper and lower facing sections **24** and **25**, respectively, which may be affixed together by means of machine screws and tapped apertures, both indicated generally by the reference numeral **26** throughout the drawings.

Gimbal housing **23** has a circular body portion **81** and a plurality of extending ears **27**, **29**, **31** and **33** formed integrally therewith and spaced in approximately square fashion. Ear **27** has a V-shaped recess **28** therein which terminates in a partial circular aperture. Ears **29**, **31** and **33** each have one circular aperture therein, the apertures being designated by the reference numerals **30**, **32** and **34** respectively.

Pivotably affixed to ear **31** on gimbal housing **23** at **36** is a latching lever **35**. Latching lever **35** has a generally semi-circular recess **37** formed integrally therein and positioned such as to overlie aperture **32** when latching lever **35** is pivoted to its locked position, that being the one shown in FIG. 2. Also affixed to gimbal housing **23** and positioned in operative relationship with latching lever is a latching lever retainer, indicated generally by the reference numeral **38**. Latching lever retainer **38** is preferably fabricated from some type of resilient metal such as spring steel and is affixed to the gimbal housing at **39** in such a manner that it is biased down against the latching lever **35** as viewed in FIG. 2. Retainer **38** has an upwardly curved lip **40** (see FIG. 5) and a shoulder offset **41** formed integrally therein near the free extremity thereof.

Housing **23** has a pair of outer gimbal pivot receiving shoulders **42** affixed oppositely thereacross and a pair of outer gimbal limits **43** displaced 90 degrees therefrom. As shown best in FIG. 5, each of the shoulders **42** receives a gimbal pivot pin **44** for securing the outer gimbal to the housing. The pin is non-rotatably fixed to the housing. Pivot pins **44**, for example, may be press fitted into gimbal housing **23**. A pair of generally cylindrical bearings **45** having spacing shoulders **46** enclose those sections of pivot pin **44** which extend from gimbal housing **23**. These bearings, conveniently, may be fabricated from nylon, acetal resin or other detergent resisting materials. The cylindrical sections of bearings **45** are enclosed by a pair of circular bearing receiving openings **47** in outer gimbal **22**. As shown best in FIG. 3, the circular bearing receiving openings **47** are formed by semi-cylindrical mating grooves in the upper and lower sections **24** and **25**, respectively, of outer gimbal **22**. Outer gimbal **22** has a pair of gimbal stops **48** affixed thereto as shown best in FIG. 4. These gimbal stops serve to limit the degree of pivotable movement allowed outer gimbal **21** with respect to limits **43** on gimbal housing **23** to insure that outer gimbal **21** will not pivot to an angle interfering with the smooth power transmission from the motor to the floor implement.

As shown best in FIG. 4, inner gimbal **21** also has a pair of pivot pin receiving openings **53** into which are press fitted outer gimbal-inner gimbal pivot pins **49**. Nylon bearings **50**, having spacing shoulders **51** thereon, surround pivot pins **49** and have their cylindrical sections received by circular bearing receiving openings **52** formed by facing sections **24** and **25** of outer gimbal **22**. As shown best in FIG. 2, the pivotal movement between gimbal housing **23** and outer gimbal **22** occurs about an axis which is displaced 90 degrees to the axis about which the pivotal movement between inner gimbal **21** and outer gimbal **22** occurs. The pivotable movement of inner gimbal **21** with respect to outer gimbal **22** is also limited so as to insure that it does not pivot to an angle which interferes with the smooth transmission of rotational thrust through the connection. As shown best in FIGS. 4 and 5, the ability of the gimbal to pivot is checked by the relative sizes of inner gimbal **21** and outer gimbal **22**.

Inner gimbal **21** has a shaft receiving aperture **24** extending centrally therethrough. Opening **54** may conveniently be provided with a keyway **55** to which rotatable connection with shaft **13** on motor **12** is made. A suitable recess **56** is provided in the bottom of inner gimbal **21** for receiving retaining cap **16** (see FIG. 1).

Referring now to FIGS. 1, 6 and 7, the details of the implement retaining plate **14** and its inter-connection with gimbal structure **20** will be described. Implement retaining plate **14** may conveniently take the form of a circular plate having a recessed open section **66** in the center thereof with a shoulder **67** extending upwardly to the plane of the plate. A plurality of suitable apertures **69** are spaced around the periphery of the plate such that the desired implement may be affixed thereto by means of screws. In ordinary usage, one implement retaining plate **14** would be provided for each type of implement to be utilized in conjunction with the floor treatment unit and the implements would be removed therefrom only when it was necessary to replace them.

Abutting the periphery of circular recess **66** are a plurality of upstanding implement retainers **60**, **61**, **62** and **63**. As shown best in FIG. 7, each of the implement retainers has a rounded upper surface to assist their passage into suitable receiving apertures on the gimbal structure. Retainer **60** is provided with a recessed shoulder section **64** which is adapted to receive locking latch **35**. Retainer **63** is provided with a small flat retaining plate **65** which is spaced from plate **14** a sufficient distance to permit passage of ear **27** on gimbal structure **20** therebetween.

## OPERATION

One of the salutory features of the present invention is the ease with which the gimbal structure may be assembled. Once the parts therefor have been fabricated, and pivot pins **44** and **49** pressed into their respective places.

the nylon bearings 45 and 50 may be placed therearound, the upper and lower sections of the outer gimbal brought together so as to receive all of the cylindrical bearing sections in apertures 47 and 52 and the upper and lower sections, 24 and 25 respectively, of the outer gimbal affixed together. The gimbal structure may then be affixed to shaft 13 where it will remain during all periods of normal operation.

From FIGS. 2, 4 and 5, it will be seen that outer gimbal 22 is free to pivot within the limits prescribed by the co-action of stops 43 and 48 about pivot pins 44. Note, as shown in FIG. 5, bearing 45 remains rotatably affixed to outer gimbal 22 and both rotate around the pivot shafts 54. The spacing between the gimbal housing 23 and the outer gimbal 22 is maintained by shoulders 46 on bearings 45.

Similarly, inner gimbal 21 is free to rotate or pivot within outer gimbal 22 within the limits provided by the relative sizes of the two gimbals about pivot pins 49. In this case, however, as shown in FIG. 4, bearings 50 remain rotatably stationary in outer gimbal 22 while pivot pins 51 rotate within them. The spacing between the inner and outer gimbals is maintained by shoulders 51 of bearings 50.

When it is desired to affix an implement retainer plate 14 to the unit, it is necessary only to lift the plate to gimbal structure 20 which is affixed to the shaft of the motor and slide ear 27 beneath mating plate 65 on plate retainer 63. Sufficient clearance is allowed between plate 14 and retainer 65 to permit this sliding action. The V-shape of recess 28 permits easy alignment beneath plate 65 and, as the plate is slid with respect to the gimbal structure, positions the cylindrical shaft of retainer 63 within its circular vertex. Once this positioning has been achieved, the plate 14 is pushed completely into engagement with gimbal structure 20 such that, as viewed in FIGS. 2, 6 and 7, plate retainer 61 passes into and is received by aperture 32 on ear 31 and retainer 62 passes into and is received by aperture 34 on ear 33.

At this point, latching lever 35 is moved to the position shown in FIG. 2. The semi-circular recess 37 on lever 35 passes into recessed shoulder 64 on brush retainer 60 in such a manner that, as long as the latching lever is maintained in that position, brush 14 cannot be disengaged from gimbal structure 20. That is to say, that the shoulder section of retainer 60 overlaps latching lever 35 so as to prevent the plate from being pulled therefrom.

As latching lever 35 is being moved into the position shown in FIG. 2, the upwardly sloping lip 40 of latch retainer 38 acts as a camming surface. Since latch retainer 38 is fabricated from resilient material which ordinarily biases it into the position shown in FIG. 5, the movement of latching lever 35 forces latch retainer 38 upwardly until such time as retainer shoulder 41 in retainer 38 slides over and engages latching lever 35. The detent, of course, retains latching lever 35 in the position shown in FIG. 2 until such time as the forward end 40 is manually raised. When this is done, latching lever 35 may be pivoted outwardly to allow the brush plate to be removed from gimbal structure 20 and replaced by a new or different type of implement. As indicated in FIG. 1, the structure of the unit is such that latching lever 35 and forward lip 40 of retainer 38 protrude from beneath frame 11 so as to be accessible to the operator.

Once the proper implement plates have been installed and the unit is activated, gimbal structure 20 smoothly and efficiently transmits the rotational thrust of motor 12 to the implement which is abutting the floor. The rotatable bearing thrust between implement plate 14 and gimbal structure 20 is transmitted by the sides of apertures 28, 30, 32 and 34 bearing against retainers 60, 61, 62 and 63. The latch does not have to sustain these loads. Rotational thrust is transmitted within the gimbal structure by the various pivot pins which pivotably connect the housing to the outer gimbal and the outer gimbal to the inner gimbal. The gimbal structure provides about 5° of angular displacement of the floor tool from the axis of the shaft.

As floor contours are encountered, this angular displacement or tilt allows the brush to assume any position within the limits dictated by the relative sizes of the inner and outer gimbals and by the co-action of pivot limits 43 and 48. This freedom to tilt, as pointed out previously, insures that the rotational thrust of the motor 11 will be transmitted evenly and smoothly to the rotating floor implement. This allows retention of the motor in a nearly vertical position such that its center of gravity will be approximately above the axis of rotation of the implement at all times to prevent localized surface grabbing at particular sections of the implement and subsequent loss of control of the unit by the operator. Where, as shown in FIG. 1, tandem units are being utilized, each of the floor implements will be allowed to deviate from their normal planar positions a sufficient amount to insure proper floor treatment and to prevent localized grabbing.

While a preferred embodiment of this invention has been described in detail, it will be readily apparent to those skilled in the art that the concepts disclosed in this application may be readily adapted to a vast number of other physical embodiments. Such other embodiments are to be deemed as included within the scope of the following claims unless these claims, by their language, expressly state otherwise.

We claim:

1. Apparatus for affixing a brush retaining plate to a motor having a rotatable shaft extending therefrom, said apparatus comprising:

a gimbal structure having a housing, an outer gimbal pivotably mounted within said housing for pivotable movement about one coordinate axis with respect to said housing, said outer gimbal having an aperture in the central portion thereof and an inner gimbal mounted substantially within said aperture for pivotable movement about another coordinate axis with respect to said housing, said inner gimbal having a pair of gimbal pivot pins projecting from the exterior periphery thereof, said pins being received by said outer gimbal at the interior periphery of said aperture;

means for affixing said shaft to said inner gimbal such that said gimbal structure rotates with said shaft; and

means for affixing said gimbal housing to said brush retaining plate such that the rotatable thrust of said shaft is transferred to said brush retaining plate via said gimbal structure whereby said brush retaining plate is free to pivot about said coordinate axes with respect to said shaft but rotatable therewith.

2. The apparatus as set forth in claim 1 which further comprises means mounted for rotation with said gimbal structure for limiting the pivotable movement of said gimbals and said gimbal housing with respect to one another within predetermined limits.

3. The apparatus as set forth in claim 2 wherein said means for affixing said housing to said brush retainer plate comprises:

a plurality of upstanding retaining members and a plurality of apertures for receiving said members, said members being on one of said housing and said plate and said apertures being in the other; and

means for selectively retaining said members within said apertures.

4. The apparatus as set forth in claim 3 wherein said members are mounted to the upper face of said brush plate and wherein said means for retaining comprises:

a recessed shoulder on at least one of said members; and

a latch lever pivotably mounted to said housing, said latch lever having a section thereon adapated to mate with said recessed shoulder when said latch is pivoted into engaging relationship therewith.

5. Apparatus for affixing a brush retaining plate to a motor having a rotatable shaft extending therefrom, said apparatus comprising:

a gimbal structure having a housing, an outer gimbal pivotably mounted within said housing for pivotable movement about one coordinate axis with respect to said housing and an inner gimbal mounted substantially within said outer gimbal for pivotable movement about another coordinate axis with respect to said housing;

means for affixing said shaft to said inner gimbal such that said gimbal structure rotates with said shaft;

a plurality of upstanding retaining members mounted on the upper face of said brush plate and a plurality of retaining member mating apertures in said housing, at least one of said members having a recessed shoulder thereon;

a latch lever pivotably mounted to said housing, said latch lever having a section thereon adapted to mate with said recessed shoulder when said latch is pivoted into engaging relationship therewith whereby said gimbal housing can be selectively affixed to said brush retaining plate such that the rotatable thrust of said shaft is transferred to said brush retaining plate via said gimbal structure whereby said brush retaining plate is free to pivot about said coordinate axes with respect to said shaft but rotatable therewith; and

means mounted for rotation with said gimbal structure for limiting the pivotable movement of said gimbals and said gimbal housing with respect to one another within predetermined limits.

6. The apparatus as set forth in claim 5 which further comprises means for selectively retaining said latch lever in said engaged relationship.

7. The apparatus as set forth in claim 6 wherein said retaining means comprises a lock member resiliently affixed to said housing, said lock member having a detent thereon adapted to catch said latch lever and retain it in engaged relationship with said recessed shoulder.

8. The apparatus as set forth in claim 7 which further comprises a camming surface on said lock member adapted to be contacted by said latch lever as it is pivoted toward engaging relationship with said recessed shoulder whereby said resilient lock member is raised until such point as said detent engages said latch lever.

9. The apparatus as set forth in claim 5 wherein said members are mounted to the upper face of said brush plate and which further comprises:

a cutout section in said housing converging into one of said receiving apertures; and

a housing retainer affixed to the associated member in spaced relationship to said plate whereby the cutout section in said housing may be slid under said housing retainer until the aperture associated therewith partially surrounds and abuts that section of the upstanding member between said brush retainer plate and said housing retainer.



10. The apparatus as set forth in claim 9 wherein said retaining means comprises:

a recessed shoulder on an upstanding member generally opposite from that member having said housing retainer affixed thereto; and

a latch member pivotably mounted to said housing, said lever having a section thereon adapted to mate with said recessed shoulder when said latch is pivoted into engaging relationship therewith.

11. Apparatus for affixing a brush retaining plate to a motor having a rotatable shaft extending therefrom, said apparatus comprising:

a gimbal structure having a housing, an outer gimbal pivotably mounted within said housing for pivotable movement about one coordinate axis with respect to said housing and an inner gimbal mounted within said outer gimbal for pivotable movement about another coordinate axis with respect to said housing, said outer gimbal having upper and lower sections adapted to be sandwiched over sections of the pivotable mounting means which affix said outer gimbal to said gimbal housing and said inner gimbal to said outer gimbal during assembly of said structure;

means for affixing said shaft to said inner gimbal such that said gimbal structure rotates with said shaft;

means for affixing said gimbal housing to said brush retaining plate such that the rotatable thrust of said shaft is transferred to said brush retaining plate via said gimbal structure whereby said brush retaining plate is free to pivot about said coordinate axes with respect to said shaft but rotatable therewith; and

means mounted for rotation with said gimbal structure for limiting the pivotable movement of said gimbals and said gimbal housing with respect to one another within predetermined limits.


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