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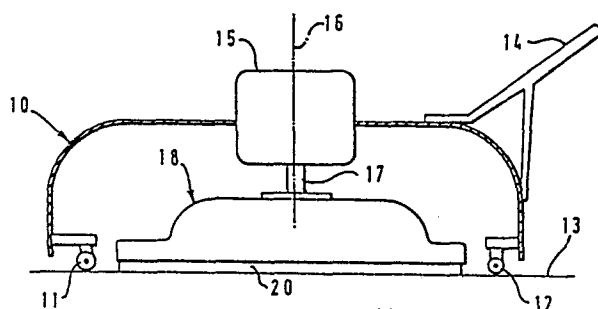
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54 **Method of and machine for treating an uneven floor surface.**

57 A floor polishing machine has a carrier (19) for a polishing pad (20), the carrier being mounted on the output shaft (17) of the motor by a dished, elastomeric member (18). The motor is supported from the floor surface by wheels and the elastomeric member urges the polishing pad against the floor surface with substantially uniform pressure.



Title: "Method of and machine for treating an uneven floor surface"

Description of the Invention

The present invention relates to a method of and to a machine suitable for treating floor surfaces, for example cleaning and polishing floor surfaces. The apparatus may be suitable for treating also other surfaces, for example wall surfaces.

In GB 2,042,331A, published September 24th 1980, there is disclosed a scrubbing machine having a frame mounted on wheels which run on the floor when the machine is in use. The frame supports an electric motor having a rotary output element on which there is mounted a first disc. A second, lower disc is connected with the first disc by coiled compression springs and by telescopic guides. A brush is carried on the underside of the second disc. The springs are said to give the desired loading of the brush against the floor to be scrubbed. The range of travel of the brush relative to the upper disc is clearly limited by the telescopic guides which limit mutual approach of the discs.

GB 2,033,214A published May 21st 1980 discloses the provision, in a floor polisher, of a discoid member which incorporates an elastomeric annulus and which is interposed between a brush and coupling means on an output shaft of the floor polisher. The elastomeric annulus includes a relatively thick central zone which tapers radially outwardly through an intermediate zone to a relatively thin portion which joins a peripheral zone. The elastomeric annulus further comprises solid projections which extend downwardly from the central zone to positions close to, but spaced upwardly from the brush. The elastomeric annulus can flex to accommodate upward movement of a part of the brush or of the brush entirely relative to the output shaft, but such movement is severely limited by engagement of the upper surface of the brush backing plate with the projections of the annulus.

In DE 3130934 A1, published February 17th 1983, there is disclosed a carpet cleaning machine having a carrier plate which is restrained against rotation relative to a housing of the machine but is driven along an orbital path by a crank. A body of elastic, foamed cleaning material is provided

around the perimeter of the carrier plate but there is no provision for upward and downward movement of the carrier plate relative to the driving means.

In DE 1008886, published May 23rd 1957, there is disclosed a floor polishing machine having a resilient connection between a polishing brush and a drive-shaft. This connection is said to accommodate relative axle movement and to accommodate limited wobble. Alternative structures for providing the resilient connection are disclosed. These structures will accommodate only limited axle movement but this may be sufficient to avoid excessive pressures between the brush and an uneven floor surface.

FR 661452, published October 3rd 1928, discloses a polishing machine having a pneumatic cushion which is inflated by a fan and is mounted on a rotatable carrier.

U.S. 3537122 issued November 3rd 1970 discloses a flexible floor-polishing disc. This disc is illustrated as being carried on a shaft of a polishing machine and there is no provision for movement of the entire disc relative to the drive means along the axis of rotation.

Notwithstanding the variety of machines known in the prior art, there is a requirement for a machine on which removable polishing pads can be used and which is capable of avoiding substantial variations in the pressure between a floor surface and the polishing pad, as between one pad and another and when a single pad is used on an uneven floor surface. Polishing pads having a wide variety of thicknesses are commonly used for polishing floors and these pads can simply be peeled from a support plate on the machine and replaced by another pad within a period of one or two seconds. Whilst it would be possible to provide for vertical adjustment of a polishing machine to accommodate changes in the pad thickness, operators are unlikely to spend time effecting such adjustment and it is desirable that the polishing machine should itself accommodate changes in the pad thickness without any action on the part of the operator, other than changing the pad.

None of the prior art hereinbefore mentioned acknowledges the foregoing requirement or provides a structure which would fulfil the requirement. In the prior art structures, relative axial movement intended to accommodate uneven floor surfaces. The relative axial movement which is required to accommodate uneven floor surfaces is small. Furthermore, it is necessary to control closely movement of the polishing implement relative to the driving shaft in a direction transverse to the axis of rotation. This is particularly important in modern polishing machines, where high rotational

speeds are generally used. These considerations have led designers of prior art machines to restrict relative axial movement to a small value.

It is an object of the present invention to provide a floor polishing machine having a carrier plate for carrying a polishing pad and means for transmitting torque to the carrier plate from driving means of the machine, which transmitting means is capable of accommodating relatively large axial displacements of the carrier plate relative to the driving means and without large differences in the respective pressures which the carrier plate exerts on polishing pads having different thicknesses.

According to the invention, there is provided a machine having a body, driving means mounted on or in the body and including a motor, a carrier plate for engaging a polishing pad during use of the machine to rotate the pad in contact with a floor surface and transmission means for transmitting torque from the driving means to the carrier plate, wherein the transmission means includes a concave disc of resiliently flexible material having a central portion, a circumferential portion with a flat surface facing away from the central portion, the central portion having a flat surface facing away from the circumferential portion, and an intermediate portion extending from a radially inner margin of the circumferential portion to a radially outer margin of the central portion, the intermediate portion being curved in one direction only, as viewed in cross-section in a plane containing a diameter of the disc, and the disc having flexibility such that said flat surfaces of the isolated disc can be moved into a common plane without exceeding the elastic limit of the disc.

The concavity of the disc is preferably such that said flat surface of the central portion lies in a plane space at least two inches from said flat surface of the circumferential portion, when the disc is unstressed.

The elasticity of the disc is preferably such that a force not exceeding 25lbs will deform the disc from the unstressed configuration into a configuration in which said flat surface of the central portion lies in the same plane as does the flat surface of the circumferential portion.

An example of a floor polishing machine embodying the invention will now be described, with reference to the accompanying drawing, wherein:-

FIGURE 1 shows diagrammatically a side view of the machine, certain parts being broken away; and

FIGURE 2 shows a diametral cross-section through a transmission element of the machine of Figure 1.

The machine illustrated in Figure 1 comprises a hollow body 10 which is open at its underside and is provided with front wheels 11 and rear wheels 12 for supporting the body in a stable manner on a floor surface 13. Typically, there may be two rear wheels and two front wheels positioned at the corners of a notional square. At least one pair of the wheels 11 and 12 may be incorporated in castors but, in the example illustrated, the respective axes of rotation of the wheels are maintained mutually parallel.

The wheels 11 and 12 are arranged to maintain the body 10 at a predetermined height above the floor surface 13. Whilst the wheels may be adjustable, with respect to height, this will not generally be necessary.

The body 10 is provided with a handle 14, by means of which the body can be propelled across the floor surface and by means of which the body can be tilted to raise the front wheels 11 clear of the floor surface 13, in order that the body can be steered easily by means of the handle.

The body 10 supports a motor 15 which is fixed with respect to the body and is therefore supported at a predetermined height above the floor surface 13. The motor has an armature (not shown) which is rotatable about an axis 16 of the motor and to which there is secured an output shaft 17 of the motor. A transmission element 18 connects the output shaft with a carrier 19 for a polishing pad 20 or other tool, with which the floor surface 13 is to be treated. The axis 16 of the motor is vertical, when the wheels 11 and 12 rest on a horizontal floor surface, and lies between those wheels, either at or near to the centre of the body 10. In a case where the wheels 11 and 12 define a notional square, the axis 16 may be at the centre of that square.

The carrier 19 has a circular periphery, centred on the axis 16. The polishing pad 20 is a circular disc and is intended to have a concentric relation with the carrier.

The carrier and the polishing pad may be of respectively known forms, for example the polishing pad being of bonded fibrous material and the carrier having prongs which penetrate into the polishing pad. The carrier is a fairly stiff plate which has the form of a disc. The prongs may be pressed out of the plate.

It will be noted that the carrier 19 and polishing pad 20 are mounted for rotation about the axis 16 of the motor 15 and will rotate at the same speed as does the armature of the motor. At the lower end of the output shaft 17, there is provided a flange which is perpendicular to the axis 16. The transmission element 18 comprises a substantially flat, central portion 21 which may be annular in shape and in which there are formed holes to receive bolts or other fastening elements for securing the transmission element to the flange of the motor output shaft. At the underside of the central portion, there is provided a metal annulus formed which corresponding holes, through which the fastening element protrude. The central portion of the transmission element 18 is gripped between this annulus and the flange of the shaft 17 and presents flat, mutually parallel faces towards the annulus and flange, these faces being perpendicular to the axis 16.

The transmission element further comprises a peripheral portion 22 which also is annular in shape and is flat. In the peripheral portion are formed apertures for receiving further bolts or other fasteners, by means of which the carrier 19 is secured to the transmission element. Thus, the peripheral portion is fixed with respect to the carrier and is not permitted to flex significantly. As shown in Figure 2, the peripheral portion of the transmission element may be provided with a downwardly projecting lip 23 for embracing the periphery of the carrier, to ensure a coaxial relation between the carrier and the transmission element.

The lower surface of the peripheral portion 22 of the transmission element defines a reference plane 24 which, when the transmission element is unstressed, is perpendicular to the axis 16. When the transmission element is unstressed, this plane is spaced considerably from the underside of the central portion 21 of the transmission element. The spacing between the underside of the central portion and the plane 24, in the unstressed transmission element, is at least one twentieth of the overall diameter of the transmission element and is preferably at least one tenth of that diameter. The spacing may be as great as one third of the diameter.

The central portion 21 and the peripheral portion 22 of the transmission element are connected by an intermediate portion 25 which, as viewed in cross-section along a radius of the transmission element, is of substantially arcuate form, preferably approximating to the arc of a circle. The cross-section of the intermediate portion at the opposite side of the axis 16 preferably approximates to the arc of a further circle, having the same

radius. The radius of curvature of the internal surface of the intermediate portion 25, as viewed in cross-section in a plane containing a radius of the transmission element, is preferably greater than the spacing of the central portion 21 from the plane 24, but not more than twice this spacing. In the preferred transmission element, the intermediate portion is continuous, circumferentially of the element, and is devoid of discontinuities. The thickness of the intermediate portion is substantially uniform throughout the intermediate portion. The intermediate portion has substantially uniform thickness.

Alternatively, the curvature of the internal surface of the intermediate portion 25, as viewed in cross-section in a plane containing a radius of the transmission element, approximates to an arc of a single circle. For a transmission element of given overall dimensions, thickness and composition, a transmission element having this particular form is capable of flexing in a manner to bring the central portion into co-planar relation with the peripheral portion somewhat more easily than in the transmission element illustrated in Figure 2. However, the invention, in its widest aspect, is not limited to the provision of a transmission element having an intermediate portion with an internal surface which, as viewed in cross-section in a plane containing a radius of the transmission element, is substantially an arc of a circle. Other curves may be used, provided the intermediate portion is curved in a single direction only, in contra-distinction to a corrugated form. Whilst corrugations also increase the ease with which the transmission element can be flexed to bring the central portion into co-planar relation with the peripheral portion, corrugations also increase the ease with which the transmission element can be flexed to move the circumferential portion laterally relative to the central portion, thereby establishing an eccentric relation, which, in use, with the transmission element and carrier rotating at high speed could at least give rise to severe vibration.

The intermediate portion 25 is elastomeric in character and has a thickness such that the central portion 21 can be displaced to the plane 24 so that the entire lower surface of the central portion coincides with that plane. The intermediate portion 25 is preferably formed integrally with the central portion 21 and the peripheral portion 22, as a moulding of an elastomer.

The properties of the material of which the transmission element is formed and the thickness of the intermediate portion 25 are selected so that, with the transmission element separated from other components of the

machine and with the peripheral portion 22 resting on a horizontal, annular surface, the application to the central portion 21 of a downwardly directed and evenly distributed force not exceeding 12 Kg will displace the central portion sufficiently to bring the upwardly facing, flat surface thereof into the plane 24. Preferably, the force required to displace the upwardly facing surface of the central portion to the plane 24 does not exceed 9 Kg. This ease of flexibility ensures that substitution of a thick polishing pad, for example a pad having a thickness of 65 mm, for a thin pad, for example a pad having a thickness of only 12 mm, does not result in a much greater contact pressure between the pad and a floor surface.

The preferred forms of the intermediate portion 25 are such that the additional force required to move the upwardly facing surface of the central portion 21 towards the plane 24, after the surface has been moved a substantial distance towards that plane, is slight, for example two or three Kg only. The additional force required to move the central portion 21 through the last 12 mm of travel to bring the upwardly facing surface of the central portion into the plane 24 does not exceed 3 Kg.

Deformation of the transmission element to move the upwardly facing surface of the central portion 21 into the plane 24 does not stress the transmission element to the elastic limit. In fact, movement of that surface through and beyond the plane 24 could be achieved without stressing the transmission element beyond the elastic limit, but such deformation cannot occur in practice.

It will be understood that the weight of the machine illustrated in Figure 1 is far in excess of the force which will produce complete deflection of the transmission element 18. The weight of the machine is transmitted to the floor surface 13 primarily by the wheels 11 and 12. A minor proportion of the weight of the machine is transmitted to the floor surface via the transmission element. If the machine is raised from the floor surface, the transmission element will support the polishing pad 20 with at least the lower surface of that pad below the plane to which the wheels extend. Accordingly, when the machine rests on a flat floor surface, the transmission element is stressed to some degree and the polishing pad is urged against the floor by a force which approximates fairly closely to a predetermined value, typically 3 Kg.

If the machine is used on an uneven floor surface, traversing of hollows or bulges by one or more of the wheels 11 and 12 will cause the body 10 to

tilt slightly so that the axis 16 is temporarily inclined at a few degrees to the vertical. Such tilting of the body is accommodated by the transmission element 18 without tilting of the carrier 19 occurring. Thus, even when the body of the machine is tilted slightly, the pressure exerted by the polishing pad on the floor surface 13 will remain evenly distributed and substantially uniform. Furthermore, in the event of all four wheels entering depressions in the floor surface so that the motor 15 approaches somewhat more closely to that part of the floor surface which lies directly beneath the motor, there will be no substantial increase in the pressure under which the polishing pad 20 engages the floor surface.

As the polishing pad wears away, the pressure under which the polishing pad is urged against the floor surface will be maintained substantially constant by the transmission element. The distance between the motor 15 and the underside of the polishing pad is adjusted automatically by the transmission element to maintain the required contact pressure with the floor. Similarly, if a pad of one thickness on the carrier is substituted by a pad having a different thickness, the transmission element will maintain substantially the same contact pressure between pad and floor. There is no provision for the operator to set the carrier 19 in a predetermined position relative to the motor.

The motor 15 is intended to operate at a speed in the region of 1-2000 r.p.m. The transmission element 18 is effective to maintain the centre of the carrier 19 on the axis 16 of the motor. This is so, even when the plane 24 defined by the transmission element is deflected a few degrees from a perpendicular relation to the axis. The means for transmitting torque from the motor to the carrier is particularly simple and relatively inexpensive, as compared with known arrangements where the carrier rotates about an axis which is off-set from the axis of the motor, a belt and pulley transmission being provided to transmit torque from the motor to the carrier.

However, in a floor polished in accordance with the invention, the transmission element may be arranged to rotate about an axis which is offset from the motor axis, a belt and pulley or other means being provided for transmitting torque from an output shaft of the motor to a shaft on which the transmission element is mounted. This arrangement is useful if the polishing pad and carrier are required to rotate at a speed different from the motor speed.

CLAIMS:

1. A machine having a body (10), driving means mounted on or in the body and including a motor (15), a carrier plate (24) for engaging a polishing pad (20) during use of the machine to rotate the pad in contact with a floor surface and transmission means for transmitting torque from the driving means to the carrier plate, wherein the transmission means includes a concave disc (18) of resiliently flexible material having a central portion (21), a circumferential portion (22) with a flat surface facing away from the central portion, the central portion having a flat surface facing away from the circumferential portion, and an intermediate portion (25) extending from a radially inner margin of the circumferential portion to a radially outer margin of the central portion, the intermediate portion being curved in one direction only, as viewed in cross-section in a plane containing a diameter of the disc, and the disc having flexibility such that, when the disc is isolated from other components of the machine, said flat surfaces of the disc can be moved into a common plane without exceeding the elastic limit of the disc.
2. A machine according to Claim 1 wherein said flat surface of the central portion (21) extends to the outer periphery of the central portion, said flat surface of the circumferential portion extends to the radially inner periphery of the circumferential portion (22) and wherein the thickness of the intermediate portion (25) is substantially uniform throughout the intermediate portion.
3. A machine according to Claim 1 or Claim 2 wherein the concavity of the disc (18) is such that said flat surface of the central portion lies in a plane spaced at least two inches from said flat surface of the circumferential portion, when the disc is unstressed.
4. A machine according to Claim 3 wherein the elasticity of the disc is such that the exertion on the isolated disc of a force not exceeding 12 Kg will deform the disc from the unstressed configuration into a configuration in which said flat surface of the central portion lies in the same plane as does the flat surface of the circumferential portion.

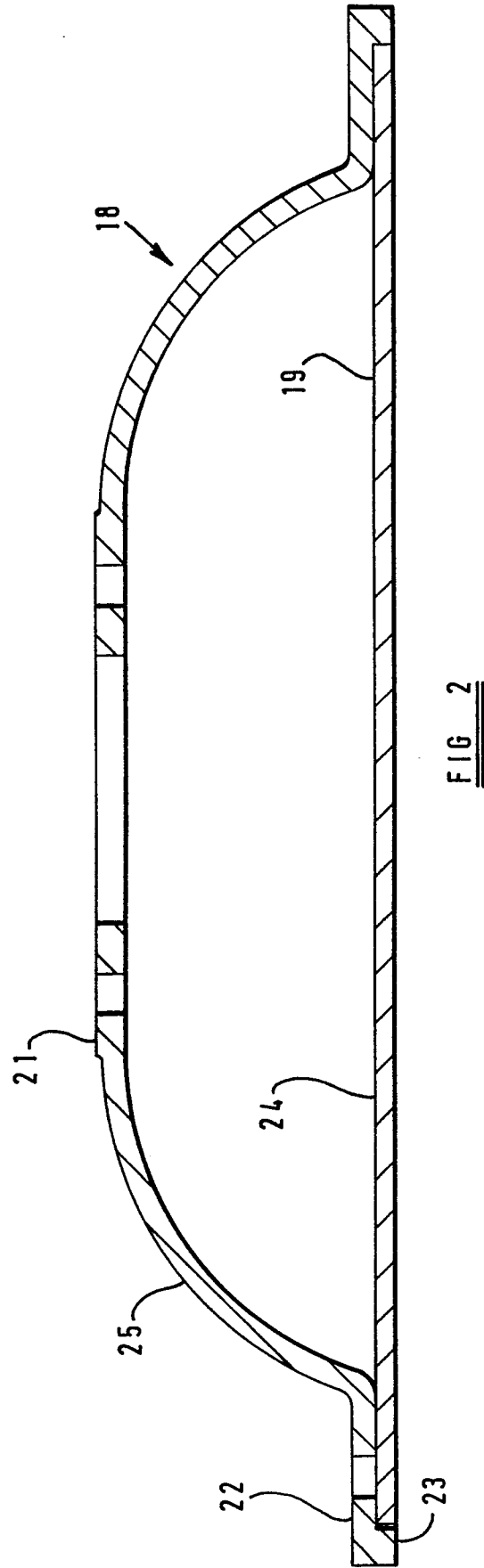
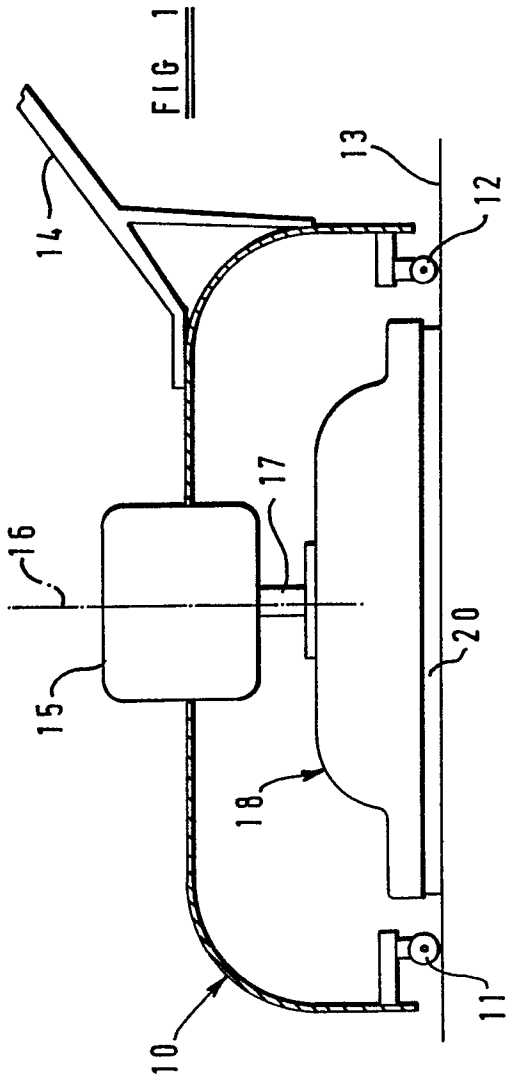
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5. A machine according to Claim 4 wherein the elasticity of the disc is such that, when the isolated disc has been stressed sufficiently to bring said flat surface of the central portion into a position 12 mm from the plane containing said flat surface of the circumferential portion, subjection of the disc to an additional force not exceeding 3 Kg will cause the flat surface of the central portion to move into said plane.

6. A machine according to any one of Claims 3, 4 and 5 wherein the intermediate portion (25) of the disc, as viewed in cross-section in a plane containing a radius of the disc, is an arc of a circle.

7. A machine according to Claim 6 wherein the radius of said arc exceeds the spacing of said flat surface of the central portion (21) from the plane containing the flat surface of the circumferential portion (22), when the disc is unstressed, by a factor not exceeding two.

8. Any novel feature or novel combination of features disclosed herein or in the accompanying drawing.





European Patent
Office

EUROPEAN SEARCH REPORT

0182178

Application number

EP 85 11 3981

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
D,A	DE-B-1 008 886 (LICENTIA PATENT-VERWALTUNGS AG) * Whole document *	1,2	A 47 L 11/164
D,A	GB-A-2 042 331 (JANATEX SUPPLIES LTD.)		
D,A	DE-A-3 130 934 (VORWERK & CO.)		
D,A	FR-A- 661 452 (N.B. WALES)		
D,A	US-A-3 537 122 (J.R. PROFFITT Jr.)		
			TECHNICAL FIELDS SEARCHED (Int. Cl. 4)
			A 47 L
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 26-02-1986	Examiner MUNZER E.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	