FLOOR MACHINE FOR HAZARDOUS ATMOSPHERES

Bernard J. Wilke, Chicago, Ill., assignor to Hild Floor Machine Co., Chicago, Ill., a corporation of Illinois

Filed May 23, 1957. Ser. No. 608,612

14 Claims. (Cl. 15—49)

This invention relates to floor polishing and scrubbing machines, particularly to such machines having a motor driven, rotatably mounted brush mounted upon the bottom of a frame having an upwardly and rearwardly extending post assembly carrying handle bar means at the top thereof for maneuvering the floor machine easily about the floor being scrubbed or polished.

Due to the friction developed between the brush tufts of the machines and the floor, appreciable static charges of electricity can build up upon the frame of the machine itself which can create a hazard in explosive atmospheres if the sparks escape from the machine into the atmosphere or if the atmosphere seeps into the machine. Although some efforts have heretofore been made to reduce the static charges build up on the floor machines, for the most part, they have left much to be desired.

It is, accordingly, one of the objects of the present invention to provide a floor scrubbing or polishing machine which is kept substantially free of static charge build-up upon the frame of the machine under practically all operating conditions which can be reasonably anticipated.

Another object of the invention is to provide a floor polishing or scrubbing machine wherein the machine is sealed against passage of sparks from within the machine to the surrounding atmosphere and wherein the explosive material in the atmosphere cannot readily gain access to the parts of the machine where sparking is readily possible.

Still another object of the invention is to provide a floor polishing or scrubbing machine having the above-mentioned upstanding post assembly which is constructed in a novel and improved manner to increase the strength and rigidity thereof. A further object of the invention is to provide an upstanding post assembly for a floor machine which is so related to the handle bar means at the top thereof and the rest of the frame of the machine that a low resistance path for flow of static charges of electricity are provided between and including the handle bar means and the floor brush.

With the conventional type floor machines, a dangerous condition exists if the power cord plug attached to the power cord of the machine is accidentally pulled out of the electric outlet socket and the operator leaves the machine to correct the condition without first switching the conventional type on-off to the “off” position. In such case, when the power plug is reinserted into the electric outlet socket the machine is turned on while unattended, resulting in the resumption of rotation of the brush which can drive the unguarded machine against unsuspecting persons, furniture or machinery.

Accordingly, a still further object of the invention is to provide a floor machine which cannot be started if left unattended so as to avoid the above-mentioned situation if the power cord plug should be accidentally pulled from the power outlet socket.

In accordance with one aspect of the invention, all or an appreciable number of the brush tufts are rendered conductive to static electricity and electrically connected to the frame of the machine which is made of metal or other good conductor of static electricity. The important feature of this construction is that the static-charge-conducting brush tufts are well distributed over the bottom of the machine to ensure good electrical contact with the floor even when the brush assembly is tilted into positions where the brush tufts do not all make contact with the floor or when the brush tufts are worn unevenly resulting in poor contact between some or even a few of the brush tufts and the floor.

In the case of wet scrubbing machines or polishing machines, the usual required brush tuft characteristics preclude the use of all-metal brush tufts and, in such case, in accordance with the invention only a small proportion of the strands in each brush tuft are made of a highly conductive and non-sparking material, preferably nickel plated silver, so that the over-all physical characteristics of the brush tufts are not substantially affected by the conductive metal strands which nevertheless effectively ground the brush tufts. To obtain best results, each of the tufts includes conductive metal brush strands distributed therethrough in an amount which may comprise at least approximately 10% by volume of the strands thereof. The remainder of the strands are the usual non-metallic fibers, such as bassine, nylon, rayon fibers, etc. In the so-called dry scrubbing brushes for cleaning concrete or wood block factory floors, all of the strands are made of fairly rigid electrically conducting, non-sparking metal wire strands. In both types of brushes referred to above, the brush tufts are preferably electrically connected together by metal wires secured upon a support plate which carries the tufts. The wires are electrically connected to a metal mounting ring at the center and top of the plate and the ring physically and electrically connects the support plate to a rotor driven by an electric motor.

Usually, floor scrubbing and polishing machines are provided with casters for quickly and easily moving the machine from place to place, the casters being retractable so that the floor machine is supported solely upon the brush assembly when actually polishing or scrubbing the floor. Additionally, these floor machines are often provided with rubber bumper cups for cushioning the machine against shocks due to collisions between the machine and surrounding objects and to prevent the marring of such objects during such collision. In accordance with the most preferred form of the invention, not only are the brush tufts rendered conductive, but both the casters and the rubber bumper cups are made of a special rubber which is a conductor of static electricity and which prevents the accumulation of static electricity so that grounding of static charges is provided at all usual points of contact between the machine, the floor and surrounding objects.

As a further safety feature, the handle bar means at the top of the hollow post assembly are rendered conductive to static electricity. Preferably the handle bar means has a metal core surrounded by a covering of a special rubber which is treated to be conductive to static electricity. The rubber covering is preferably secured to the metal core by a static-charge conducting cement so that good electrical contact is made between the rubber covering and the core of the handle bar means. The metal core, in turn, is electrically connected to the hollow post assembly which is electrically connected to the brush tufts, casters and bumper.

In floor machines of the type now being discussed, the electric motor is usually enclosed in a housing section above the brush assembly and an electrical connection to the motor is obtained through conductor wires extending down a hollow post assembly and through an opening in the housing assembly. The conductor wires are con-
connected to an on-off switch usually at the top of the post assembly from which a power cord extends to a suitable power outlet or is insertable into an electrical outlet socket. In accordance with the invention the various joints or couplings between the point of entry of the power cord into the top of the post assembly and the point of entry of the conductor wires into the motor housing are rendered practically impervious to the passage of sparks from within the machine to the surrounding atmosphere and to the passage of the explosive elements in the atmosphere, particularly dust and powder, into the machine. Most preferably, a suitable sealing compound fills the space between the inner wall surface of a conduit carrying the wires from the post assembly to the motor housing section and the conductor wires at their point of entry into the motor housing. Also, the opening at the bottom of the motor housing section through which the motor shaft passes is sealed against the passage of sparks from the motor housing section and explosive mixtures from the surrounding atmosphere.

As an additional safety feature, to prevent the application of power to the machine when it is left unattended, an on-off switch controlling the flow of electric power to the machine is provided with a control lever which is spring biased to the "off" position and which is turned on by the hand of the operator as it grips the handle bar means. Removal of the operator's grip from the handle bar means requires release of the control lever which is then automatically returned to the "off" position by its biasing spring.

Other features of the invention reside in the details of construction of the mounting post assembly and the means for connecting the post assembly to the other parts of the machine. These features together with still other features of the invention are described in the specification to follow, the claims and the drawings wherein:

FIG. 1 is a side elevational view of the floor machine of the present invention;
FIG. 2 is a plan view of the machine of FIG. 1;
FIG. 3 is an enlarged fragmentary plan view at the base and rear of the machine showing the manner in which the bumper guard assembly is secured around the base of the machine;
FIG. 4 is an enlarged vertical section through the bumper of the floor machine, along section line 4-4 in FIG. 7 of FIG. 5;
FIG. 5 is an enlarged, partially vertical sectional view through the housing and post assemblies;
FIG. 6 is a horizontal sectional view through the gear assembly, taken along section line 6-6 in FIG. 5;
FIG. 7 is a longitudinal sectional view showing a part of the gear section extending between the post assembly and the housing assembly, taken along section line 7-7 of FIG. 5;
FIG. 8 is a sectional view through the rotor assembly taken along section line 8-8 in FIG. 5, with the brush assembly appearing in a fragmentary plan form;
FIG. 9 is an exploded view showing the coupling parts which secure the brush tuft support plate to the rotor assembly;
FIG. 10 is an enlarged vertical section through the brush tuft support plate, showing the manner in which the brush tufts are secured thereto;
FIG. 11 is an enlarged fragmentary vertical section through a portion of a modified form of brush assembly;
FIG. 12 is a fragmentary plan, partially broken away, of the modified brush assembly of FIG. 11;
FIG. 13 is a perspective view of a cluster of brush sections making up each of the brush tufts in the modified form of brush assembly in FIGS. 11 and 12;
FIG. 14 is a partial vertical sectional view of the caster assembly, taken along section line 14-14 in FIG. 2;
FIG. 15 is an enlarged sectional view through a part of the machine base, taken along section line 15-15 in FIG. 2;
FIG. 16 is an enlarged side elevational view, partly broken away, of the switch and power cord connector at the top of the post assembly;
FIG. 17 is a longitudinal sectional view through the switch box and handle bar assemblies, taken along section line 17-17 in FIG. 16; and
FIG. 18 is a top end view taken along line 18-18 of FIG. 16.

Referring now to the drawings, the floor machine there shown includes a housing assembly 4 comprising an upper motor housing section 6 containing an electric motor, not shown, and a lower brush assembly housing section 8 containing a brush assembly 10 and other mechanism to be described which couples the motor to the brush assembly. The machine further includes a hollow post assembly 12 supported from the housing assembly and a switch control and handle bar assembly 14 by means of which the operator controls the operation and movement of the floor machine. Electric power is delivered to the machine through a power cord 15 attached to the switch control and handle bar assembly.

As above indicated one of the important novel aspects of the invention is the construction of the brush assembly 10 which is constructed to provide a large number of evenly distributed static charge grounding points with the floor to inhibit the buildup of static charge on the floor machine which might produce sparks in a dangerous condition where the machine is used in hazardous atmospheres commonly found in chemical plants, paint plants, refineries, distilleries, floor mills, etc. The drawings show two generally different types of brush assemblies, one type being shown in FIGS. 5, 8 and 10 which may be used for polishing and wet scrubbing, and the other type being shown in FIGS. 11 through 13 which may be used for dry scrubbing.

In the type shown in FIGS. 5, 8, and 10, each of the brush tufts, generally indicated by the reference numeral 16, is comprised predominantly of non-metallic brush strands 18 (FIG. 10), such as bassine, palmetto, union fibers or nylon, depending upon their use, which may be polishing or wet scrubbing in accordance with the invention. Conductive wire strands 20 are distributed throughout the non-metallic brush strands to make the brush tufts conductive to static electricity. The strands making up each tuft are substantially of equal length and are bunched together with their ends in alignment. Then they are folded into an inverted U-shape so that all their ends are in approximately the same plane at the bottom of the brush assembly. In this way the conductive strands make contact with the floor with the other strands to effectively ground any static charges which may tend to build up on the brush tufts or other parts of the machine electrically connected thereto. Since the metal conductive brush strands form only a small proportion, say 10 percent, of the strands in each tuft, the physical properties of the tuft are, primarily, determined by the non-metallic brush strands which are specifically adapted for the particular kind of polishing or scrubbing job to be performed by the brush assembly. In one example, the non-metallic fibers were bassine and the conductive fibers were 0.005 inch diameter nickel plated silver wire, constituting at least approximately 10 percent by volume of the strands in each tuft.

The tufts 16 are secured to a tuft support member, the tuft comprised preferably of a metal backing plate 22 preferably of a non-ferromagnetic material, such as cast aluminum, zinc, brass or the like, having a large number of tuft mounting bores 24 formed or molded in the bottom face thereof which are distributed along a number of concentric circles. A wire pass-through opening 25 connects the top of each bore 24 to the top surface of the tuft support plate 22. The tufts within each
circle are secured within the bores 24 by a metal wire 26 extending along the top of the plate. The wires pass down through the pass-through openings 25 into the bores 24 and are looped under the ends of the brush tufts which have been extended up into the bores 24 and then pass up through the pass-through openings to suspend fixedly the brush tufts in the bores 24. The wires 26 associated with the concentric circular rows of brush tufts may actually be part of one long piece of wire which may be interconnected by jumper wires so that all of the tufts are electrically connected together. The wire section associated with the innermost circle of brush tufts is electrically connected to a mounting ring 28 either by a direct soldered connection thereto or by soldering the wire to any suitable place on the support plate which in turn is electrically connected through the metal of the plate to the ring which is fixed by screws 30 to the top of an upwardly extending cylindrical neck portion 32 (FIG. 5) at the center of the tuft support plate.

At the perimeter of the tuft support plate is an upwardly extending annular skirt 38 which forms a liquid confining wall which surrounds the brush assembly for use with a water supply tank, not shown, often used with floor scrubbing machines. The tank is mounted on the hollow post assembly 12 of the floor machine and has a supply tube which connects with a fitting 37 on the top of the housing section 8 and directs soapy water onto the top of the tuft support plate 22. For this purpose, a series of concentric grooves 39 are formed in the top surface of the tuft support plate 22 between the circular rows of wire pass-through openings 25. A series of downwardly diverging water supply holes 40 are formed in the bottom of the grooves 39 to distribute a stream of soapy water on the floor adjacent each brush tuft.

Referring now most particularly to the mounting ring 28 shown most clearly in FIGS. 5 and 9, the central opening 42 thereof is provided with three equally spaced radial slots 44 which are sized to receive similarly shaped radial projections 43 with beveled upper side edges 43' extending from a cylindrical neck portion 45 depending from a rotor assembly 46. Surrounding the top of the cylindrical neck portion 45 of the rotor assembly is a downwardly facing annular shoulder 47 which overlies the radial projections 43.

The mounting ring 28 has a tapered thickness formed by shaping the under surface 44' of the ring so that it progressively inclines downwardly from points adjacent each radial slot 44 proceeding in a counter-clockwise direction as viewed from above the ring, and the thus resulting sloping surfaces each terminate in a depending prong 48. The top surface of the ring is flat and the thickness of the ring adjacent to the base of each prong matches the spacing between the top of the radial rotor projections 43 and the bottom of the annular rotor shoulder 47. Thus, the mounting ring 28 and the attached tuft support plate can be mounted upon the rotor assembly by raising the brush assembly to bring the mounting ring slots 44 over the radial projections 43 of the rotor assembly and, when the radial projections 43 are below the bottom surface 44' of the ring, then twisting the mounting ring clockwise as viewed from above the ring which wedges the mounting ring in the space between the radial rotor projections 43 and the rotor shoulder 47 by camming action brought about by the shape of the undersurface 44' of the mounting ring. Since the rotor assembly is rotated in a counter-clockwise direction, the rotation of the rotor tends to maintain the mounting ring in its extended position on the rotor.

Instead of the brush assembly 10 above described, the embodiment shown in FIGS. 11 through 13 may be used when dry scrubbing concrete or wood block factory floors. The modified brush assembly is indicated generally by the reference numeral 10' and includes brush tufts 16 each formed by a cluster of superimposed stiff beryllium cop-

per wires bent into the inverted U shape down in the drawings. For example, the wires may have a generally rectangular cross section 0.150 inch wide and 0.021 inch thick. These copper wire brush tufts are mounted upon a tuft support member which may comprise a pair of correspondingly shaped, circular wooden backing parts 22' and 22''. If desired, the backing parts 22' and 22'' could also be made of a non-ferrous, non-sparking metal.

The brush tufts extend through respective tuft receiving bores 24' extending completely through the lower backing part 22', which bores are preferably uniformly arranged along a number of concentric circles. The brush tufts are arranged in a random manner in the various bores 24' with the bent back intermediate portions thereof protruding a small distance above the top surface of the lower backing part 22'. The tufts are each securely held in place within the bores 24' by a pair of wires 26'—26'' passing together through the loops formed by the protruding upper portions of the brush tufts. Two wires are placed alongside one another rather than utilizing a single wire of larger diameter in order to reduce the vertical space required thereby since a single circular wire of larger diameter would occupy a greater vertical space. In addition to their function of suspending the tufts in the bores 24', these wires electrically interconnect the various brush tufts. If separate pairs of wires are utilized to interconnect the brush tufts of adjacent concentric circles of brush tufts, then the wires of the adjacent circular rows of brush tufts are electrically interconnected by suitable cross-connecting wires. In the illustrated embodiment, a pair of continuous wires are used to interconnect the brush tufts.

The wires 26'—26'' are electrically connected to the same mounting ring 28 above described by a jumper wire 26' hooked around and soldered to one of the innermost brush tufts at the bottom of the lower backing part 22'. The wire 26'' extends through central apertures in the backing parts and terminates beneath the head of one of the screws 30, which are made of non-sparking metal and anchor the mounting ring to the upper back part. The two backing parts 22' and 22'' are secured together by non-sparking metal bolts 31 passing through aligned holes in these parts, the heads of the bolts being recessed within counterbored portions of the holes in the upper backing part 22'' and the ends of the bolts receiving non-sparking metal nuts 32' nestled within recesses formed in the bottom face of the lower backing part 22'. The connection of this brush assembly to the rotor assembly is the same as described above for the combination assembly 10.

The rotor assembly 46 upon which the brush assembly is mounted is comprised of a pair of superimposed hollow complimentary casting parts 50 and 51 which are secured together in any suitable way along a pair of confronting edges thereof, and the lower casting part 50 has the reduced cylindrical neck portion 44 previously alluded to, from which project the radial projections 43.

The rotor assembly 46 is rotatably supported upon upper and lower ball bearings 58—58' mounted upon a stationary gear and ball bearing assembly 59. The gear and ball bearing assembly 59 includes upper and lower frame parts 60 and 61 which have confronting engaging flanged portions 62 and 63 secured together by machine screws 64. The flanged portion 62 merges with an upwardly extending cylindrical collar portion 65 around which is press-fitted or otherwise secured the aforementioned lower ball bearing 58. The flanged portion 66 of the lower collar portion 67 has a reduced depending stepped collar portion 67' around which is mounted the lower ball bearings 58'.

The upper and lower collar portions 65 and 67 have respectively mounted within suitably shaped internal recesses upper and lower ball bearings 69 and 70 which rotate to support a drive shaft 71. A drive pinion 73 is mounted on an intermediate portion of the drive shaft 71 which pinion meshes with three idler gears 75 (see FIG. 6) mounted within respective recesses 77 formed in the flanged por-
The gears 75 are each mounted upon ball bearings 78 mounted upon respective pins 79 secured within aligned openings in flanged portions 62 and 63 of frame parts 61 and 62. The gears 75, in turn, mesh with an internal ring gear surface 80 formed on the inner peripheral surface of the lower rotor casting part 58. Thus, rotation of the drive shaft 71 will rotate the drive pinion 73 to in turn rotate the idler gears 75 meshing with the internal gear surface 80 of the rotor assembly which rotates the brush assembly.

A splined steel coupling 81 is keyed to the top of the drive shaft 71 and meshes with the splined end 82 of the electric motor shaft. The motor shaft 82 passes into the motor housing section 6 through a sealed opening in the bottom wall of the motor housing section, the seal preventing the passage of any sparks into the motor housing section and explosive atmosphere into the motor housing section. As a further aid in preventing the intermixing of sparks and explosive atmosphere, a plug 83 is inserted into the opening at the bottom of the depending cylindrical neck portion 45 of the rotor assembly.

The upper collar portion 65 of the gear and bearing assembly 59 is secured by machine screws 84 to a hollow stationary hub portion 86 from which radially extend webs 88 joining the cylindrical, intermediate housing part 90. The intermediate housing part 90 sits upon an upwardly facing annular shoulder 92 of the brush housing section 8. The motor housing section 6 has a peripheral flange 94 at the bottom thereof which rests upon the top of the intermediate housing part 90. The various parts 6, 59 and 8 of the bearing assembly are held together by screws 96 passing through openings in the motor housing section flange 94 and the intermediate housing part 90 and threading into the top of the brush housing section 8. A gasket ring 98 is preferably placed between the bottom of the intermediate housing part 90 and the annular shoulder 92 at the top of the brush housing section.

The brush housing section 8, which may be a metal casting as in the case of the other frame parts above described, has a depending annular skirt portion 102 which is spaced appreciably outwardly of the rotor assembly 46. A bumper guard assembly 105 is secured around the bottom of the brush housing skirt 102 and includes a hollow rectangular body 106 (see FIGS. 4 and 5) of flexible rubber which is rendered conductive to static electricity in any suitable way, such as by the inclusion of above mentioned carbon black in the latex from which the rubber is initially made. The bottom wall of the rubber body 106 rests upon an outwardly flared lip 107 formed at the bottom of the brush housing skirt 102. The rubber body is held securely upon the lip 107 by a suitable angle bracket 108 made of flexible metal strip material secured by screws 109 to the skirt 102, the bracket having an upwardly extending leg which forms a channel with the housing lip 107 into which the rubber body 106 may snugly be fitted and held by its own resiliency. A conductive metal band 110 is passed through the passage 111 within the hollow rubber body 106 and the ends of the band are bent and curled at 112 to form eyelets which receive a headed clamp bolt 114 on the end of which is threaded a nut 116 which clamps the band and hence the rubber body 106 snugly around the bottom of the brush housing section 8 at the rear thereof. The brush housing section 8 is grounded in a manner to be more fully explained hereinafter and the static charge conducting rubber bumper body 106 is similarly grounded through its contact with the brush housing section so that no sparking can occur when the rubber bumper body contacts any similarly grounded object as the floor machine is being moved about the floor.

The brush housing section, which may be a metal casting, includes as an integral part thereof an upwardly and rearwardly extending boss 122 (FIGS. 1, 5 and 14) disposed between a pair of rearwardly extending, caster assembly support arms 123—123. The boss 122 is provided with a post assembly mounting socket 126, the axis of which extends upwardly and rearwardly normal to the axis of the hollow post of the assembly 12. A cylindrical nose 128 depends from the post assembly and fits within the socket 126 where it is locked securely therein by headless screws 129 respectively threading into holes drilled in the top and sides of the boss and tightly engaging the nose 128.

The caster mounting arms 123—123 are provided with aligned openings 130—130 in which are fixedly mounted a long metal pivot pin 131 whose ends project laterally beyond the sides of the arms 123—123. A pair of metal pivot pins 132—132 are fixed upon the ends of the pin 131, and a pair of metal axles 133—133 are fixed to the project laterally outwardly from the pivot arms along aligned axes spaced from the axis of the pin 131. Casters 134—134 are mounted upon the axles 133—133, the casters being held on the axles by end caps 135—135' threaded over the ends of the axles. One of these caps 135' has an appreciable length so that it may be readily engaged by the foot of the operator which pivots the associate caster and pivot arm connected to the pivot pin 131. Since the other pivot arm and caster are fixed to the pivot pin, they pivot with the caster and arm associated with the long end of the pivot pin. These casters can be swung from the position shown in FIGS. 5 and 14, where the casters engage the floor, to the retracted position shown in dotted lines in FIG. 5, where the pivot arms 132—132 rest upon pins 136—136 (FIGS. 2, 3 and 5) spaced sufficiently outwardly from the pivot pin 131 so that the center of gravity of the caster assembly is located forwardly of the pivot pin 131 so that the caster assembly is held in its retracted position by force of gravity. The caster assembly is moved into its retracted position to place the floor machine in a scrubbing or polishing position where the entire weight of the machine is carried upon the brush tufs and hence upon the frictional resistance between the brush tufs and the floor for good cleaning or polishing action. When the floor machine is to be transported from place to place within a building, the caster assembly is pivoted into the lower position and the machine is tipped so that most if not all of the weight of the machine is supported upon the casters to minimize the effort necessary to move the floor machine about.

The casters are so constructed that they form a static charge-conducting surface at their points of contact with the floor and are electrically conductively connected to the metal frame of the floor machine. Each of the casters comprises a central body portion 137 which may be made of a hard rubber or plastic material rendered conductive to static electricity, and a soft, resilient rim 138 made preferably of a soft rubber rendered conductive to static electricity. As in the case of the bumper guard body, the rubber of the caster parts 137 and 138 may be rendered conductive by the addition of above mentioned carbon black in the latex used in the manufacturing of the rubber. The central body portion 137 of each caster carries a non-sparking metal bearing 139 which rotates upon one of the axles 133. Electrical connection between the rim 138 of the caster assemblies and the brush housing section 8 is thus made via the central caster body portions, the bearings 139, axles 133, pivot arms 132 and the pivot pin 131 anchored to the arms 123—123 extending from the brush housing section. The axles 133, pivot arms 132 and pivot pin 131 are preferably made of brass to ensure good electrical contact therebetween.

The hollow post assembly 12 has near the bottom thereof of a cylindrical, open-top, metal junction box body 140 from which extends a pair of aligned, internally threaded, cylindrical fittings 141 and 142, formed integrally with the junction box body. The fitting 141 extends forwardly and downwardly and the fitting 142 extends rearwardly.
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and upwardly. The fitting 141 has a threaded socket 144 which receives the upper threaded end of the cylindrical nose 128. A ring of metal 146 is brazed or welded between the nose 128 and the bottom of the fitting 141 rigidly to fix the junction box body with respect to the nose and to provide a seal to prevent the passage of explosive atmosphere into the junction box. The other fitting 142 has a threaded socket 149 into which the bottom portion of a long metal tube 150 is threaded. The socket 149 communicates with the inside of the junction box through a pass-through opening 152. A ring of metal 151 is brazed or welded between the tube 150 and the fitting 142 to fix the two parts and to seal the junction box body from the atmosphere.

The junction box body 140 has a metal cover 153 which is secured in place by screws 161 and which encloses the open top thereof. The cover has formed integrally therewith a forwardly and upwardly extending cylindrical fitting 154 having a threaded socket 155 into which the bottom threaded end of a short metal tube 156 is threaded, the tube 156 forming part of a conduit section or assembly 157. A pass-through opening 158 interconnects the conduit section 157 with the junction box interior. A ring of metal 159 is brazed or welded between the tube 156 and the fitting 154 to form a rigid connection therebetween and to seal off the junction box from explosive atmosphere.

The upper end of the tube 156 is threaded into a socket 165 (FIG. 7) of a metal tubular member 164 forming part of an extensible sleeve assembly 166. The tubular member 164 has a pair of axially spaced peripheral flanges 168 and 170 which make sliding contact with the inner walls of metal sleeve member 173. A pass-through opening 174 in the metal sleeve member 173 may be stuffed in the space between the flanges 168-170. The outward movement of the inner tubular member 164 relative to the sleeve member is limited by a shoulder formed by an inverted end 175 of the outer sleeve member 173.

The outer sleeve member 173 is provided with a neck 178 threading into a socket 180 of a metal elbow fitting 182 projecting from the upper end of the motor housing section 6.

In addition to the various metal rings of soldering or welding material 146, 151 and 157, preventing the entry of explosive atmosphere into the machine and the passage of sparks from the machine to the atmosphere, an additional seal is provided at the fitting 182 by a moisture-proof sealing cement 185 which fills the spaces within the fitting 182.

The conduit section 157, just described, acts as a conduit for a pair of insulated power conductors 183—183 extending from the motor within the motor housing section 6. The power conductors 183—183 extend through the sealing cement 185 embedding the same in the fitting 182 at the top of the motor housing section and pass through the extensible sleeve assembly 166, and tube 156 and the pass-through opening 158 leading to the junction box interior. Within the junction box, the insulated power conductors 183-183 are joined to a pair of power conductors 183'-183' extending down the tube 150 and passing through the pass-through opening 152. The bared ends of these conductors may be spliced together in any suitable manner and covered by insulating tape 184—184 within the junction box.

The power conductors 183—183' extend up the post 150 and into a rectangular metal switch box 186 through a pass-through opening 188 in the junction box. A cylindrical fitting 190 formed integrally with the switch box projects from the latter around the pass-through opening 188, the fitting having a threaded socket 192 into which the upper end of the post 150 is threaded. A ring of metal 193 is brazed or welded between the fitting 190 and the post 150 to fix the two parts together and to provide an explosion-proof seal which prevents the passage of sparks from the switch box to the atmosphere and the passage of atmosphere into the switch box.

A partition disc 196 or suitable wadding is located inside of the post 150 adjacent to the upper end thereof and the space above the disc up to and including the pass-through opening 188 is filled with a moisture-proof sealing cement 198 to isolate the switch box from the other parts of the floor machine. The power conductors 183', of course, pass through suitable openings in the post 150 or wadding and are embedded within the sealing cement.

The switch box 186 is open at its top 200 (FIG. 16) and the opening is covered by a cover 202 which is secured to the box 186 by machine screws 204 threading into the junction box. A double pole single throw on-off switch 206 is mounted within the switch box and is supported by a bracket plate 208 and attached to mounting lugs 210 extending inwardly from the outer walls of the switch box by machine screws 212. The switch mechanism may be any of a number of well known varieties of switches including an operating shaft 214 (FIG. 18) which controls the movement of the movable contact poles of the switch. A switch operating arm 215 is connected in any suitable way to the operating shaft 214. The arm 215 may be formed as an assembly of two spaced arm pieces 215—215 extending between the ends of which a roller 216 is pivoted mounted.

An operating lever assembly is mounted upon the cover 202 of the switch box and includes a rocker shaft 217 which is journaled in a suitable bearing mounted in the cover walls. An extension arm 218 is secured to the rocker shaft 217 within the cover 202 and has a pair of bifurcated ends 219—219 which straddle the roller 216. The rocker shaft 217, which extends forwardly from the switch box cover along a line generally parallel to the post 150, carries a control lever 220. The control lever 220 is urged into a position where the switch 206 is in its "off" position by any suitable spring means, such as by a spring 222 secured at one end to a lug 227 associated with the operating shaft 214 and anchored at the other end to a stationary part of the switch. The position of the control lever 220 in the "off" position of the switch is shown in solid lines in FIG. 18 and as shown, extends upwardly away from the switch box. The switch is operated to its "on" position by pulling the lever 220 against the restraining force of the spring 222 in FIG. 18. As the control lever is rotated, the arm 218 likewise rotates and the bifurcated ends 219 of the switch operating arm 215 and hence the switch contacts into a switch closing position. If the operator releases the control lever it will automatically move to its "off" position under control of the spring 222.

The control lever 220 is arranged to operate in combination with one of a pair of handle bar assemblies 228—228 so that the operator may grasp one of the handle bar assemblies and hold the control lever with the same hand in the "on" position, shown in dotted lines in FIG. 18. Then, if the power cord should pull out of the power control socket when the operator leaves the machine to plug the power cord back into the outlet, the machine will remain off even when the power cord is plugged into the outlet, because, upon release of the operator's grip on the handle bar assemblies, the control lever 220 automatically snaps back into its "off" position.

The handle bar assemblies 228 each comprises a solid, cylindrical metal core 230 which is threaded into a socketed fitting 232 formed integrally with and projecting from the switch box 186. The fittings 232—232 associated with the respective handle bar assemblies extend laterally of the switch box. Respective rings of metal 234—234 are brazed or welded between the fittings 232—232 and the metal cores 230—230 to anchor these parts together and to seal the switch box from the surrounding atmosphere. Immediately surrounding each of the cores 230—230 is a soft rubber covering 236 which is rendered conductive to static electricity in the same manner as the rubber bumper body.
106 previously described. The rubber covering may be cemented to the associated metal core by suitable cement 238 which is likewise rendered conductive to static electricity. In this way, the handle bar assemblies are electrically conductively connected to the frame of the machine through the connection of cores 230—230 with the switch box, which in turn is secured to the hollow post assembly 12, the conduit section 156 and the housing assembly 4 through the various conductive fittings and connections above described. The ends of the handle bar assemblies are covered by suitable discs 240—240 which are secured to the core ends by recessed machine screws 242—242.

One of the handle bar cores 230 has a projecting portion 244 which projects into the switch box through a pass-opening 247. A terminal lug 248 is held in place against the end of the projecting portion 244 by the head of a screw 246. The terminal lug 248 is connected to a ground conductor 249 associated with the power cord to be used with the floor machine.

The upper ends of the power conductors 184—184 extending up through the post 150 into the switch box are secured to terminals on the switch 266. When the switch is closed, the power conductors 183' are connected to the switch by a pair of power conductors 252 extending also from the switch. The power conductors 250 together with the grounded conductor 249 extend through a pass-through opening 252 formed in the bottom wall of a switch box into the threaded socket 253 of a cylindrical fitting 254 depending from the switch box 186. The conductors 250—250 and 249 then pass into the connector assembly 15 through a right-angle metal elbow 256 which is threaded into and brazed in position in the socket 253 of the fitting 254. The end of the elbow 250 opposite the end secured into the socket 253 extends downwardly in a direction parallel to the post 150 and has a threaded socket 258 which threadedly receives the end 260 of an insulating part 262 of the connector assembly 15, which insulating parts 262 may be made of Bakelite or other suitable material and which has connecting terminals 264 to which the conductors 266 of a three-conductor power cord (FIG. 1) are secured by screws 269.

The insulating part 262 receives the three power conductors 249, 250—250 in metal lined sockets (not shown) formed therein, and the terminals 264 thereof are secured in any suitable manner to the metal lining of these sockets.

The power connector assembly 15 further includes an inner metal sleeve 271 which may have fingers which interlock with the insulating part 262 and an outer metal sleeve 272 which is threaded around the top of the insulating part 263 and has an inner turned bottom end 274 which holds the inner sleeve securely upon the insulating part 262. The inner sleeve 272 has a tapered bottom opening 273 into which a rubber sleeve 276 with a tapered head 278 complementary to the tapered opening 274 extends. The rubber sleeve 276 is held in place with respect to the outer sleeve 272 by a suitable clamping part 280 which is screwed to a complementary clamping part 282 formed integrally with the sleeve 272. The various parts of the connector assembly 15 above described are so connected together that the interior of the connector assembly is sealed off from the outside atmosphere by a resilient insulating connector is provided.

The Bakelite insulating part 262 is relatively fragile and to prevent the transmission of large shock forces to the insulating part, a metal ring 283 is secured around the lower end of the elbow 286 by screws 285—285. The ring 283 has a larger diameter than the outer sleeve 272. Should the floor machine fall backwards, the ring 283 will strike the floor first and it and the elbow 286 will take most of the shock forces instead of the sleeve 272 and the Bakelite insulating part 262.

As above explained, the various fittings and connec-

tions throughout the floor machine provide explosion-proof connections to isolate the inside and outside of the machine. These explosion-proof features, together with the fabrication of all external parts of the machine out of static conducting materials (including the brush tufts, bumper, casters and handle bars) which are electrically connected to form a metal housing provides an exceedingly safe floor machine usable practically in all explosive atmospheres for floor scrubbing and polishing operations.

It should be understood that numerous modifications may be made of the preferred forms of the invention above described without deviating from the broader aspects of the invention.

I claim as my invention:

1. A floor machine comprising a metal housing assembly having on the bottom thereof a brush assembly mounted for rotation about a generally vertical axis and including a tuft support member and a large number of floor-engaging, non-sparking, static-charge-conducting brush tufts depending from and distributed over the bottom surface of said support member, said housing assembly including a motor housing section, an electric motor supported in said motor housing section and connected in driving relationship to said brush assembly, a hollow upstanding metal post connected to and extending upwardly from said housing assembly, handle means at the top of said post having hand-engaging portions made of a static-charge-conducting material, the various points of connection between said handle means, support post, and motor housing section being impervious to passage of sparks from within said machine to the atmosphere and explosive atmosphere into the machine, and said hand-engaging portions of said handle means, support post, housing assembly and brush tufts being electrically interconnected to provide a low resistance path of flow of static charge from the handle means to the brush tufts.

2. A floor machine comprising a metal housing assembly having on the bottom thereof a shock and mar preventing bumper projecting therefrom made of a soft, static-charge-conducting material which is electrically connected to said metal housing assembly, a brush assembly mounted on the bottom of the housing assembly for rotation about a generally vertical axis and including a tuft support member and a large number of floor-engaging, static-charge-conducting brush tufts depending from and distributed over the bottom surface of said support member, said housing assembly including a motor housing section, an electric motor supported in said motor housing section and connected in driving relationship to said brush assembly, a hollow upstanding metal post connected to and extending upwardly from said housing assembly, handle means at the top of said post having hand-engaging portions made of a static-charge-conducting material, the various points of connection between said handle means, support post, and motor housing section being impervious to passage of sparks from within the machine to the atmosphere and explosive atmosphere from without the machine, and said hand-engaging portions of said handle means, support post, housing assembly and brush tufts being electrically interconnected to provide a low resistance path of flow of static charge from the handle means to the brush tufts.

3. A floor machine comprising a metal housing assembly having on the bottom thereof an open-bottom brush housing section, a shock and mar preventing bumper projecting from said brush housing section made of a soft, static-charge-conducting material which is electrically connected to said metal housing assembly, a brush assembly mounted in the brush housing section for rotation about a generally vertical axis and including a tuft support member and a large number of floor-engaging, static-charge-conducting brush tufts depending from and distributed over the bottom surface of said support member, casters having a rim made of a soft, resilient static-charge-conducting material supported at the bottom of
the machine and electrically connected to said metal housing assembly, said housing assembly including a metal housing section, an electric motor supported in said motor housing section and connected in driving relationship to said brush assembly, a hollow upstanding metal support post connected to and extending upward from said housing assembly, handle bar means at the top of said post having hand-engaging portions made of a static-charge-conducting material, the various points of connection between said handle means, support post, motor housing section and brush housing section being impervious to passage of sparks from within the floor machine and explosive atmosphere from without the machine into the machine, and said hand-engaging portions of said handle means, support post, housing assembly and brush tufts being electrically interconnected to provide a low resistance path of flow for static charges between the handle means and brush tufts.

4. A floor machine comprising a metal housing assembly having on the bottom thereof a brush assembly mounted for rotation about a generally vertical axis and including a tuft support member and a large number of floor-engaging, static-charge-conducting brush tufts depending from and distributed over the bottom surface of said support member, said housing assembly including a motor housing section, an electric motor supported in said motor housing section and connected in driving relationship to said brush assembly, a hollow upstanding metal support post extending upward from said housing assembly, a hollow metal conduit section extending laterally from said post and jointing said motor housing section, handle means having hand-engaging portions at the top of said post made of static-charge-conducting material, a power cord with a ground conductor, power leads connected to said motor at one end and passing through said conduit section and up through said post to a point near the top thereof, connector means at the top of said post interconnecting said power leads and power cord, means for electrically connecting the ground conductor of said power cord to one of said static-charge-conducting portions of the machine, the various points of connection between said power cord, connector means, handle means, support post, conduit and motor housing section being impervious to passage of sparks from within the floor machine and explosive atmosphere into the machine, and said hand-engaging portions of said handle means, support post, housing assembly and brush tufts being electrically interconnected to provide a low resistance path of flow for static charges between the handle means and brush tufts.

5. A floor machine comprising a static-charge-conducting housing assembly having on the bottom thereof a brush assembly mounted for rotation about a generally vertical axis and including a tuft support member and a large number of floor-engaging, static-charge-conducting brush tufts depending from and distributed over the bottom surface of said support member, said housing assembly including a motor housing section, an electric motor supported in said motor housing section and connected in driving relationship to said brush assembly, a hollow upstanding static-charge-conducting support post extending upward from said housing assembly, handle means at the top of said post, said power leads and power cord joined to said post at a point near the top thereof, and connector means at the top of said post interconnecting said power leads and power cord, means for electrically connecting the ground conductor of said power cord to one of said static-charge-conducting portions of the machine, and said hand-engaging portions of said handle means, support post, conduit, housing assembly and brush tufts being electrically interconnected to provide a low resistance path of flow for static charges between the handle means and brush tufts.

6. A floor machine comprising a static-charge-conducting housing assembly having an open-bottom brush housing section, a brush assembly mounted in the brush housing section for rotation about a generally vertical axis and including a tuft support member and a large number of floor-engaging, static-charge-conducting brush tufts depending from and distributed over the bottom surface of said support member, said housing assembly including a motor housing section above said brush housing section, an electric motor supported in said motor housing section and connected in driving relationship to said brush assembly, a hollow upstanding static-charge-conducting support post extending upward from said housing assembly, a hollow conduit section extending laterally from said post and jointing said motor housing section, handle means at the top of said post, said handle means including metal core means and a hand-engaging covering thereover made of a soft, static-charge-conducting material intimately secured to said metal core means, a power cord with a ground conductor, power leads connected to said motor at one end and passing through said conduit section and up through said post to a point near the top thereof, and connector means at the top of said post interconnecting said power leads and power cord, means for electrically connecting the ground conductor of said power cord to one of said static-charge-conducting portions of the machine, and said hand-engaging portions of said handle means, support post, conduit, housing assembly and brush tufts being electrically interconnected to provide a low resistance path of flow for static charges between the handle means and brush tufts.

7. In a floor machine, a static-charge-conducting housing assembly, a brush assembly supported at the bottom of said housing assembly and having electrically connected to said housing assembly, a motor housing section, an electric motor in said motor housing section drivingly connected to said brush assembly, a static-charge-conducting bumper extending around and projecting outwardly from the bottom of said housing assembly, means for electrically connecting said bumper to said housing assembly, pivotally mounted casters supported from said housing assembly, said casters being pivotable into an extended position where they movably support the floor machine for movement from place to place and into a retracted position where the machine is supported completely upon the brush assembly, each of said casters having a rotatably mounted caster body made of a non-sparking material conductively connected to said housing assembly, said caster body having a floor engaging rim made of a soft, resilient non-sparking material which is a good conductor of static electricity and is conductively joined to the said caster body, and a post extending upwardly from said housing assembly and handle means at the top of said post, said handle means and post being conductively connected together and to said housing assembly, whereby to prevent the building up of an appreciable static charge on said floor machine.

A floor machine for use in connection with other machines comprising a conductive housing assembly, an electric motor supported in said housing assembly, a brush assembly at the bottom of said housing assembly, said brush assembly being mounted for rotation about a generally vertical axis and having static-charge-conducting brush tufts depending therefrom which are electrically connected to said housing assembly, means in said housing assembly for mechanically coupling said motor to said brush assembly, a metal
hollow post assembly mechanically and electrically connected to its bottom to said housing assembly and extending upwardly and outwardly therefrom, a switch box at the top of said post assembly electrically connected to said post and having a ring of brazing material sealing off the mouth of said socket between the handle bar cores and the switch box, a covering of static-charge-conducting rubber around each of said handle bar cores and electrically connected thereto, an off switch unit within said switch box and having a shaft extending through an opening in said switch box to the outside thereof, an operating lever secured to the end of said operating shaft, spring means biasing said operating lever to a position which operates said switch to its "off" position, said operating lever being movable against the restraining force of said spring means to a position which operates the switch to its "on" position, said operating lever in said latter position extending adjacent to said handle bar means so that the switch may be held in said position by the same hand of the operator which operates the handle bar means, and power conductors extending from said switch unit, down said hollow post assembly and into said housing assembly where they make electrical connection with said motor.

9. A floor machine for use in explosive atmospheres comprising a housing assembly, an electric motor supported in said housing assembly, a brush assembly being mounted for rotation about a vertical axis and having brush tufts depending therefrom, means coupling said motor to said brush assembly, a hollow post assembly extending upwardly and outwardly from said housing assembly and including a conduit section extending laterally from said hollow post assembly and joined to said housing assembly, said conduit section including an extensible sleeve portion for adjusting the over-all length thereof, a switch box having an internally threaded socket in the bottom thereof in which the upper end of said hollow post assembly is threaded, an on-off switch in said switch box including manual operating means for the switch on the outside of said switch box which extends through an opening in the switch box, a power cord connector attached to the junction box including power terminals for respective connection to the power conductors of a power cord, and insulated conductors extending between said power cord conductor terminals and said on-off switch and through said hollow post assembly and conduit section into said housing assembly where they make connection with said motor.

10. A floor machine for use in explosive atmospheres comprising a metal housing assembly, an electric motor supported in said housing assembly, a brush assembly at the bottom of said housing assembly, said brush assembly being mounted for rotation about a generally vertical axis and having static-charge-conducting brush tufts depending therefrom, means in said housing assembly mechanically coupling said motor to said brush assembly, and including means electrically connecting said brush tufts to said housing assembly, a hollow post assembly mechanically and electrically connected at its bottom to said housing assembly and extending upwardly and outwardly therefrom, a metal switch box mechanically and electrically connected to the top of said post assembly, said switch box having an external threaded socket in the bottom thereof which opens onto the box interior and into which the upper end of the post assembly is threaded, a ring of brazing material sealing off the mouth of said socket to render the switch box and post assembly relatively immobile and to prevent passage of sparks from the switch box and explosive atmosphere into the switch box, aligned, laterally facing, external threaded sockets formed in the opposite sides of said switch box which sockets open onto the interior of the switch box, conductive handle bar means threaded into each of said aligned switch box sockets, and a covering of static-charge-conducting rubber around each of said handle bar cores and electrically connected thereto, an off switch unit within said switch box and having a shaft extending through an opening in said switch box to the outside thereof, an operating lever secured to the end of said operating shaft, spring means biasing said operating lever to a position which operates said switch to its "off" position, said operating lever being movable against the restraining force of said spring means to a position which operates the switch to its "on" position, said operating lever in said latter position extending adjacent to said handle bar means so that the switch may be held in said position by the same hand of the operator which operates the handle bar means, and power conductors extending from said switch unit, down said hollow post assembly and into said housing assembly where they make electrical connection with said motor.

11. A floor machine for use in explosive atmospheres comprising a housing assembly, an electric motor supported in said housing assembly, a brush assembly in the bottom of said housing assembly, said brush assembly being mounted for rotation about a vertical axis and having brush tufts depending therefrom, means coupling said motor to said brush assembly, a hollow post assembly extending upwardly and outwardly from said housing assembly and including a conduit section extending laterally from said hollow post assembly and joined to said housing assembly, said conduit section including an extensible sleeve portion for adjusting the over-all length thereof, a rigid conduit body extending between said respective upwardly and downwardly facing pass-through openings of said junction box and housing assembly, a switch box carrying handle means secured to the top of said tubular post portion, an externally threaded box, a power cord connector connected to said switch box and including terminals for respective connection to the power conductors of a power cord, and insulated conductor wires extending between said power cord connector terminals and switch box and then through said hollow post assembly and conduit section into said housing assembly where they make connection with said motor.

12. A floor machine for use in explosive atmospheres comprising a housing assembly, an electric motor supported in said housing assembly, a brush assembly in the bottom of said housing assembly, said brush assembly being mounted for rotation about a generally vertical axis and having brush tufts depending therefrom, means coupling said motor to said brush assembly, a hollow post assembly extending upwardly and outwardly from said housing assembly and including a tubular post portion threaded at the opposite end thereof, a junction box having a threaded socket opening onto the interior thereof and into which the bottom end of said tubular post portion is threaded, a ring of material sealing off the space between the socket and said hollow post portion to render the same immobile relative to one another and to prevent passage of explosive atmosphere into said housing assembly, said junction box having a portion depending from said junction box anchored to said housing assembly and an upwardly facing external threaded socket opening into the interior thereof, said housing assembly having a generally downwardly facing external threaded socket, a rigid conduit section having ends respectively threaded into said upwardly facing junction box socket and said downwardly facing housing assembly socket, said conduit section including an extensible sleeve portion for adjusting the over-all length thereof, a ring of material between one of said last two mentioned sockets and the conduit section fitting therein to provide explosive atmosphere into the machine, a switch box carrying handle means secured to the top of said hollow post portion, an off-on switch in said switch box, a power cord connector attached to said switch box and including terminals for...
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respective connection to the power conductors of a power cord, and insulated conductor wires extending between said power cord connector terminals and switch and then through said hollow post assembly and conduit section into said housing assembly where they make connection with said motor.

13. A floor machine for use in explosive atmospheres comprising a housing assembly, an electric motor supported in said housing assembly, a brush assembly in the bottom of said housing assembly, said brush assembly being mounted about a vertical axis and having brush tufts depending therefrom, means coupling said motor to said brush assembly, a hollow post assembly extending upwardly and outwardly from said housing assembly, a rigid conduit section extending laterally from said hollow post assembly and joined to said housing assembly, a switch box having a pass-through opening in the bottom thereof, means fixing the switch box to the top of said post assembly, with said last-mentioned pass-through opening in communication with the interior of the post assembly, an on-off switch in said switch box including manual operating means for the switch on the outside of said switch box which extends through an opening in the switch box, a power cord connector attached to the junction box and including power terminals for respective connection to the power conductors of a power cord, and insulated conductors extending between said power cord connector terminals and said on-off switch and then through said hollow post assembly and conduit section into said housing assembly where they make connection with said motor, and said switch box, hollow post assembly, rigid conduit section, and housing assembly being connected by sealed joints preventing ingress of explosive atmosphere.

14. A floor machine for use in explosive atmospheres comprising a metal housing assembly, an electric motor supported in said housing assembly, said housing assembly carrying a projecting bumper guard at the bottom thereof and retractable casters for moving the machine readily about, the external surfaces of said bumper guard and casters being made of static-charge-conducting material, a brush assembly in the bottom of said housing assembly, said brush assembly being mounted for rotation about a vertical axis and including a tuft support member and a large number of floor-engaging static-charge-conducting brush tufts depending from and distributed over the bottom surface of said support member, means coupling said motor to said brush assembly, a hollow metal post assembly extending upwardly and outwardly from said housing assembly, a rigid metal conduit section extending laterally from said post assembly and connected to said housing assembly, a metal switch box secured to the top of said post assembly, handle means carried by said switch box and including static-charge-conducting portions to be gripped by the operator which portions are grounded to said metal switch box, an on-off switch in said switch box which has an operating handle spring biased to a switch-opening position and positioned to be grasped and held in a switch closing position by the same hand which grasps said handle means, a power cord connector attached to said switch box and including terminals for respective connection to the power conductors of a power cord, insulated conductor wires extending between said power cord connector terminals and switch and then through said hollow post assembly and conduit section into said housing assembly where they make connection with said motor, the various points of physical connection between said power cord connector, handle means, switch box, post assembly, conduit section and housing assembly being impervious to passage of explosive atmosphere into said machine, and said switch box, post assembly, housing assembly, external surfaces of said casters and bumper, and said brush tufts being electrically interconnected to provide a low resistance path for flow of static charges therebetween.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Inventor</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>735,797</td>
<td>McCarthy</td>
<td>Aug. 11, 1903</td>
</tr>
<tr>
<td>1,762,365</td>
<td>Nobbs</td>
<td>June 10, 1930</td>
</tr>
<tr>
<td>1,847,323</td>
<td>Yutzler</td>
<td>Mar. 1, 1932</td>
</tr>
<tr>
<td>1,930,117</td>
<td>Yutzler</td>
<td>Oct. 10, 1933</td>
</tr>
<tr>
<td>1,931,483</td>
<td>Albertson</td>
<td>Oct. 24, 1933</td>
</tr>
<tr>
<td>2,221,315</td>
<td>Okun</td>
<td>Nov. 12, 1940</td>
</tr>
<tr>
<td>2,256,983</td>
<td>Lecker</td>
<td>Sept. 23, 1941</td>
</tr>
<tr>
<td>2,426,315</td>
<td>Marick</td>
<td>Aug. 26, 1947</td>
</tr>
<tr>
<td>2,591,093</td>
<td>Okun</td>
<td>Apr. 1, 1952</td>
</tr>
<tr>
<td>2,633,519</td>
<td>Vance</td>
<td>Mar. 31, 1953</td>
</tr>
<tr>
<td>2,733,465</td>
<td>Holt</td>
<td>Feb. 7, 1956</td>
</tr>
</tbody>
</table>