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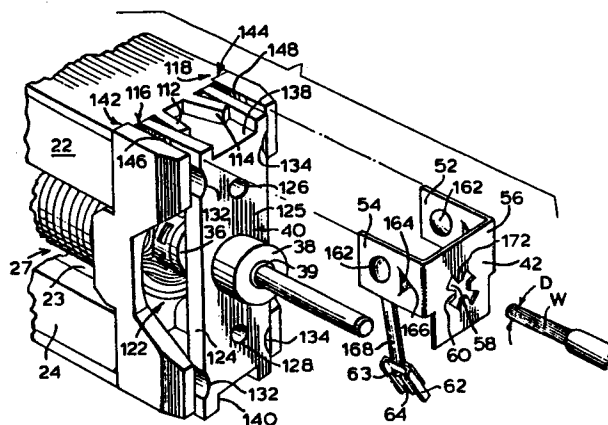
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54 **A brush gear assembly for use in a motor.**

57 A solderless electrical connection is made between a wire (W) and an electrical contact (42, 44) forming part of a brush gear assembly of an electric motor. A thin planar contact portion (56) of the electrical contact has therein an aperture (58) having a greater area than the cross-sectional area of the wire. A plurality of resilient fingers (60) are symmetrically arranged about said aperture. The distal ends of the fingers define the boundary of a wire-receiving opening in the general shape of a circle, the cross-section of the circle being less than the cross-sectional diameter (D) of the wire. When the wire penetrates the opening the fingers distort in the direction of wire penetration to prevent withdrawal of the wire.



A BRUSH GEAR ASSEMBLY FOR USE IN A MOTOR

The present invention relates to a a brush gear assembly for use in a motor.

5 In prior art motors, and especially permanent magnet motors, a brush gear is supplied that terminates at one end in a brush assembly and at its other end in an electrical contact. Typically, the electrical contact is in the form of a planar surface and is made from a material such as copper or copper alloy which readily
10 receives a conventional flux solder in order to electrically connect a wire to the motor contact. Although this method of securing a wire to an electrical contact has proved successful, it is nevertheless time consuming and adds extra cost to the
15 manufacturing process for producing small motors.

There is thus a need for a solderless connection which allows a wire to be secured to the electrical contact of a motor without the time consuming operation of soldering. The present invention is directed toward
20 filling that need.

In its broadest aspect the invention resides in a brush gear assembly for use in an electric motor and for making an electrical connection with a wire, said

assembly comprising an electrically conductive body,
including a planar contact area, an aperture defined in
said planar contact area, at least one resilient finger
arranged within said aperture such that when the wire
5 penetrates said aperture, said at least one finger
distorts in the direction of wire penetration, the
distortion of said finger(s) preventing withdrawal of
said wire from within said aperture; and means for
mounting said conductive body to said motor.

10 Preferred and/or optional features of the invention are
set forth in claims 2-6 and the invention in other
aspects is set forth in claims 7 and 8.

The invention will now be more particularly described,
by way of example, with reference to the accompanying
15 drawings in which:-

Figure 1 is a perspective view of a small permanent
magnet motor embodying the invention,

Figure 2 is a front plan view of the motor of Figure 1
with the wires removed,

20 Figure 3 is a view of the motor of Figure 1 taken along

lines 3-3,

Figure 4 is a view taken along lines 4-4 of Figure 3,

Figure 5 is a perspective view of the plastic insert used in the motor of Figure 1,

5 Figure 6 is a view taken along lines 6-6 of Figure 3,

Figure 7 is an exploded perspective view of the front portion of the motor of Figure 1, and

Figure 8 is a view taken along lines 8-8 of Figure 3.

10 With reference to Figures 1-3, the construction of a permanent magnet motor embodying the invention is presented and generally designated as 10. The motor includes a generally U-shaped motor frame 12 made from steel. The motor frame is basically two planar legs 14 and 16 that are generally parallel and spaced from
15 each other. The two legs are joined at one end by a generally planar central portion 18. The spaced legs and the central portion define a space within which is mounted a plastic spacer 20 and a pair of opposed permanent magnets 22 and 24 that surround a rotating
20 armature 26. One end of the armature terminates in a shaft portion 28 which is received within a bushing 30

that is mounted at the center of the planar central portion 18. The other end of the armature terminates in a shaft portion 34. Next to the armature and mounted on the shaft portion 34 is a commutator 36.

5 Shaft portion 34 passes through a bushing 38 that is defined as part of a non-conductive insert 40 which mates with the distal ends of the legs 14 and 16 of the motor frame 12. Also mounted on the non-conductive member 40 are a pair of brush assemblies 42 and 44.

10 The brush assemblies are identical and therefore only one will be described in detail. Taking brush assembly 42 as exemplary, the assembly basically consists of a pair of planar, opposed parallel legs 52 and 54. The legs are joined together by a planar portion 56. Near

15 the center of the planar portion 56 is a circular opening 58 that is made up of a number of symmetrically arranged, resilient fingers 60. One of the legs 52 contains an extension in the form of a brush leaf 62 within which is mounted a carbon brush 64.

20 In use, a wire W having a greater diameter D than the diameter defined between the fingers 60 is pushed into the opening 58 causing the fingers 60 to yield, allowing the wire to penetrate as shown in Figure 3. Because of their resiliency, the fingers prevent

25 withdrawal of the wire W after it has been inserted into the opening 58. In this way a solderless

connection is formed between the brush assembly and a wire W that is connected to a source of voltage for operating the motor.

With reference to Figures 1-7, a more detailed
5 description of the elements constituting the solderless connection and the motor design are presented.

Figures 1-3 show the details of a permanent magnet motor embodying the invention. The motor 10 contains a motor frame 12 consisting of a pair of flat, generally
10 parallel and spaced legs 14 and 16 joined at one end by a generally planar portion 18. The metallic motor frame 12 essentially defines the overall size of the motor. The thin metallic motor frame matches with the radial thickness of the permanent magnets 22 and 24 to
15 establish the optimum energy level in the air gap 27 between each magnet and the armature. The geometry of the motor frame allows the magnets 22 and 24 to be as wide as the width 41 of the frame thereby increasing the total area of magnetic flux and also eliminating
20 the short circuiting of flux through the sidewalls.

At the centre of the planar portion 18 of the motor frame 12, an aperture 31 is provided within which is mounted bushing 30. Within the central portion, on either side of the bushing, are defined position holes

70 and 72. The planar central portion 18 contains an interior surface 74 that receives non-conductive insert 20 generally made of a non-conductive material such as plastic. With reference to Figures 4 and 5, the insert 20 has the overall shape of a thin rectangular solid and is defined by a central portion 82 and two side portions 84 and 86. The central portion is joined to each of the side portions through the intermediary of a connecting web 88 and 90. At the center of the central portion is an aperture 92 which encircles the periphery of the bearing 30 when the insert is mounted next to the interior surface 74. The insert 20 contains two planar surfaces 96 and 98. Defined on surface 98 are a pair of projecting cylindrical bosses 102 and 104. These cylindrical bosses are spaced relative to the aperture 92 so that the cylindrical bosses mate with the apertures 70 and 72 defined on the motor frame 12. The other surface 96 of insert 20 contains upwardly projecting guide rails 105 and 107. As will be explained hereinafter, these guide rails are shaped and spaced to facilitate placement and alignment of the magnets 22 and 24 within the motor frame 12.

Each of the legs 14 and 16 of motor frame 12 terminate at their distal ends in a pair of projections 112 and 114 along with stepped cut-outs 116 and 118. These structural features mate with corresponding elements

defined in non-conductive insert 40 which is made of a suitable insulating material* such as plastic. With reference to Figures 1, 6 and 7, insert 40 generally comprises a plastic block that has an interior hollow 122 which is shaped to be larger than the commutator 36 that resides within the hollow. The outermost portion of the insert 40 defines a generally planar rectangular member 124. At the central portion of the member is defined a plastic bushing 38 that holds a metallic tubular bushing 39. At the two ends of the rectangular member are defined a pair of tubular apertures 126 and 128, which extend through the block 40 generally perpendicular to the planar surface 125 of the rectangular portion 124. Positioned on either side of each aperture 126 and 128 are a pair of indented grooves 132 and 134. These grooves each have a longitudinal axis that is generally parallel to the longitudinal axis of the apertures 126 and 128. The grooves 132 and 134 also define groove surfaces which are generally parallel to and spaced from each other. At each of the extreme ends of the rectangular member 124 is defined troughs 138 and 140. These troughs extend throughout the full width of the body 40 and define an open area for receiving legs 112 and 114. Positioned about either side of the troughs 138 and 140 are stepped inserts 142 and 144 which mate with the corresponding steps 116 and 118 of the motor frame 12.

Also defined at each end of the rectangular member 124 are a pair of slits 146 and 148. These slits receive the legs of one of the electrical contacts 42 and 44 in the manner to be described hereinafter.

5 The motor frame 12 and the two plastic inserts 20 and 40 define a space within which is mounted the pair of opposed permanent magnets 22 and 24 and the rotating armature 26. Each of the magnets is a generally rectangular solid with the major flat surface 21 of the
10 rectangular solid placed in mating relationship with the interior surface of one of the legs 14 and 16 of the motor frame 12. The opposite surface 23 of each of the magnets is curved to conform with the curved surface of the armature 26. The radius of the curved
15 surface 23 defined in the magnet is greater than the radius of the armature 26 in order to create an air gap 27 between the magnet and the armature. The side surfaces 51 and 53 (Figure 4) of each magnet are exposed and not covered by the sidewall supports found
20 in prior art motors, thus eliminating the problem of short circuiting of flux through the sidewalls.

The interior surface of insert 40 contains two edge projections 152 and 154 that contain edges 156 and 158 (Figure 8) which together define boundaries for
25 positioning the permanent magnets in the manner to be

described hereinafter.

With reference to Figures 1, 3 and 7, each of the magnets 22 and 24 are mounted within the motor frame so that the major surface area of each magnet is pressed up against the interior surface of one of the legs 14 and 16. The extreme ends of each magnet are located by each of the inserts 20 and 40 in order to stabilize the magnet. Interposed between the magnets is the armature 26 which has one end 28 in bushing 30 and the other end passing through metallic bushing 39. The commutator 36 of the motor is positioned within hollow 122 of insert 40. Also positioned within this insert in the manner to be described hereinafter is the leaf assemblies or brush gear 42 and 44.

With reference to its orientation as shown in Figure 7, brush gear 42 generally comprises a pair of horizontally extending legs 52 and 54 which are joined at their upper ends by transverse planar member 56. The planar legs are elongated and generally have a width that is less than the thickness of the planar surface. Each of the legs contains an inwardly projecting dimple 162 that rides in one of the grooves 132 and 134 when the brush gear is mounted on the insert 40. Each of the legs also contains an inwardly projecting triangular barb 164. Because the barb

terminates in a sharp point 166, once the brush gear is mounted on the insert, it is difficult to remove it because of the resistance provided by the point engaging the surface of either of the grooves 132 and 134.

Near the center of one of the legs 54, an elongated finger 168 emanates from one side of the leg. The finger terminates in a brush leaf 62 that contains an aperture 63 for receiving a carbon brush 64.

The planar surface 56 of the brush gear contains aperture 58 near its central portion. The aperture is generally square with fingers 60 emanating inwardly toward each other from each of the corners of the square. The fingers occupy the same plane as the planar surface 56 and are directed inwardly towards the center of the square. The ends of the fingers define an opening 172 that is approximately 80% of the diameter of a wire W which is to be inserted within the opening. In a preferred embodiment, the brush gear structure is approximately .11 to .12 millimeter thick with a preferred range of .08 - .15 millimeters. Likewise, in a preferred embodiment the brush gear is made of beryllium copper.

Brush gear 44 is of precisely the same construction as

brush gear 42. Each brush gear is positioned on the outer surface of insert 40 so that legs 52 and 54 are received within slits 146 and 148. Likewise, the dimples 162 and the barbs 164 are caused to ride within
5 grooves 132 and 134 as the contact is brought into its final resting place against the surface 125 of insert 40. The holes 126 and 128 in insert 40 are arranged to coincide with the opening 58 so that when a wire W is inserted into the opening 58 the end of the wire is
10 permitted to occupy up to the full length of the hole 128. Once a wire W has been inserted, the fingers 60 are caused to bend inwardly as shown in Figure 3. This inward bending prevents removal of the wire W under normal conditions of use. This construction thus
15 provides the solderless connection.

When brush gear 44 is mounted on insert 40, the brush leaf 62 and extension 168 are positioned within hollow 122 as defined by insert 40. The carbon brush 64 of brush leaf 62 is operatively associated with commutator
20 26. The size of the hollow 122 is made as large as possible in order to maximize the length of brush 64.

The above emnodiment has been given by way of example only and many modifications will be apparent to a person skilled in the art without departing from the
25 scope of the invention defined by the appended claims.

For example it may be possible to use a single resilient finger 60.

CLAIMS

1. A brush gear assembly for use in an electric motor and for making an electrical connection with a wire (W), said assembly comprising an electrically
5 conductive body (42, 44) including a planar contact area (56), an aperture (58) defined in said planar contact area, at least one resilient finger (60) arranged within said aperture such that when the wire penetrates said aperture, said at least one finger
10 distorts in the direction of wire penetration, the distortion of said finger(s) preventing withdrawal of said wire from within said aperture; and means (52, 54) for mounting said conductive body to said motor.
2. The brush gear assembly of claim 1, wherein there
15 are a plurality of said resilient fingers (60) symmetrically arranged about said aperture, the distal ends of said fingers defining the boundary of a wire receiving opening which is in the general shape of a circle, the diameter of said circle being less than the
20 cross-sectional diameter (D) of said wire (W).
3. The brush gear assembly of claim 2, wherein said

aperture (58) is square-shaped and wherein there are four fingers (60) with each finger emanating from one of the corners of said aperture along one of the diagonals of said aperture.

5 4. The brush gear assembly of anyone of the preceding claims, wherein said aperture (58) has a greater area than the cross-sectional area of the wire (W).

10 5. The brush gear assembly of anyone of the preceding claims, wherein said electrically conductive body is made from a copper alloy.

15 6. The brush gear assembly of anyone of the preceding claims, wherein said electrically conductive body comprises a pair of opposed parallel legs (52,44) joined together by a central portion, said central portion including said planar contact area; a resilient extension member (168) emanating from one of said legs, (54), said extension member terminating in a brush leaf (62); a carbon brush (64); and means for securing said
20 carbon brush to said brush leaf.

7. An electric motor having a brush gear assembly according to anyone of the preceding claims.

8. A motor including a device for creating a solderless electrical connection between a wire (W) having a given cross-sectional diameter (D) and the motor, said motor comprising a motor frame (12); an armature (26) rotatably mounted in said motor frame; a pair of opposed permanent magnets (22,24) mounted in said motor frame, each of said magnets being spaced from said armature to form an air gap (27) between said armature and said magnet; a commutator (36) secured to one end of said armature; a non-conductive member (40) mounted to said motor frame, said member defining a space (122) surrounding said commutator; an electrically conductive body (42, 44) including a planar contact area (56); an aperture defined in said planar contact area, said aperture having a greater area than the cross-sectional area of the wire (W); a plurality of resilient fingers symmetrically arranged about said aperture, the distal ends of said fingers defining the boundary of a wire-receiving opening in the general shape of a circle, the diameter of said circle being less than the cross-sectional diameter (D) of said wire so that when the wire penetrates said wire-receiving opening, said fingers distort in the direction of wire penetration, the distortion of said fingers preventing withdrawal of said wire from within

said wire-receiving opening; and means (52, 54) for mounting said conductive body to said non-conductive member.

9. The motor of claim 7, wherein said electrically
5 conductive body comprises a pair of opposed parallel
legs (52, 54) joined together by a central portion,
said central portion including said planar contact
area; a resilient extension member (168) emanating from
one of said legs (54), said extension member
10 terminating in a brush leaf (62); a carbon brush (64);
means for securing said carbon brush to said brush
leaf; and wherein a pair of opposed slits (146, 148)
are defined in said non-conductive member, said slits
receiving said opposed parallel legs to mount said
15 conductive body to said non-conductive member so that
said extension member and said brush leaf are
positioned within said space (122) to place said brush
in operative relationship with said commutator.

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