Feb. 23, 1965 J. GORDON 3,171,050

ELECTRICAL BRUSH HOLDER

Filed Oct. 24, 1962

Fig. 1

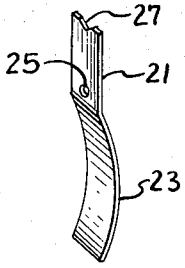


Fig. 2

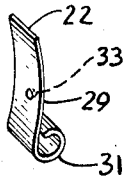


Fig. 3

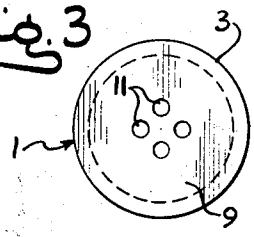


Fig. 4

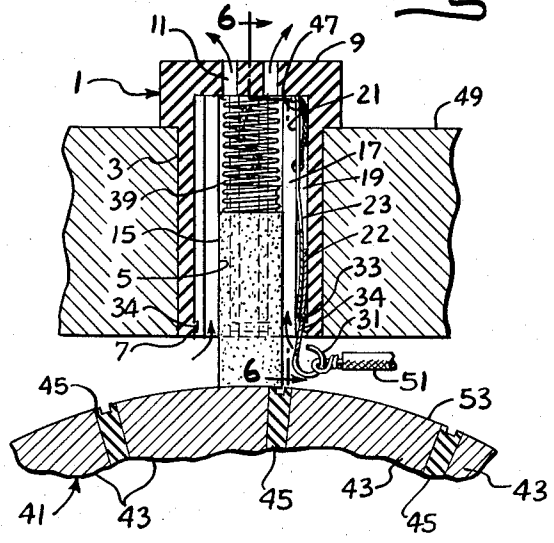


Fig. 5

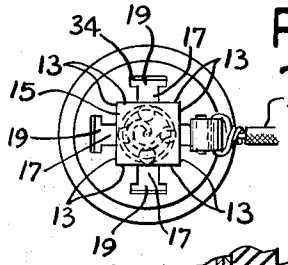


Fig. 6

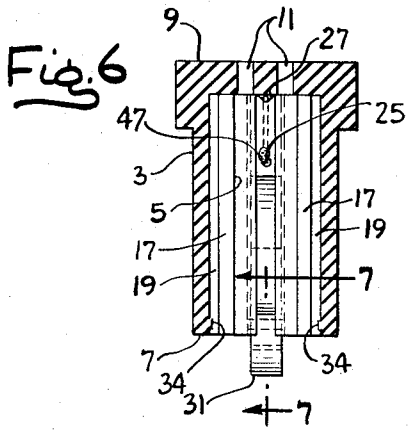
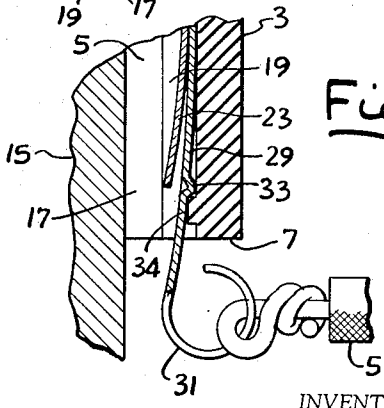


Fig. 7



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ELECTRICAL BRUSH HOLDER

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This invention relates to improvements in electrical brush holders.

In the manufacture of inexpensive electric motors for such applications as toys, small advertising displays, and the like, the brush holders are frequently fabricated entirely of a low cost molded plastic, such as a phenolic resin. Brush holders are subjected to heating during use. The plastic is ordinarily unable both to dissipate heat very rapidly and to withstand prolonged elevated temperatures without irreparable damage to the brush holder. Accordingly, these plastic brush holders have generally been suitable only for motors intended for light duty use.

It is an object of the present invention to increase the capacity and serviceability of these brush holders by inducing a flow of cooling air through them. In accordance with the preferred embodiment of the present invention, the brush holder is provided with the usual bore for receiving an electrical brush and a spring for biasing the brush into pressure engagement with the commutator of the motor. The bore in the brush holder is, however, of a substantially larger cross-sectional area than the cross-sectional area of the brush, and, furthermore, the brush holder is perforated at its end remote from the mouth of the bore to provide an uninterrupted passageway completely through the brush holder, which passageway thereby includes the part of the bore not occupied by the brush. The present invention also takes advantage of the fact that the surface of the commutator that is engaged by the end of the brush is irregular or eccentric, that is, not truly circular. These irregularities are due to the fact that in assembling the various segments of the commutator, it is exceedingly difficult to have the outer surface of each segment at the exact same radial distance from the axis of rotation of the commutator. In precision motors, machining of the commutator may be of benefit in mitigating this condition, but careful machining of this type cannot be expected in low priced motors. The irregularities may vary from a true circle by only a few thousandths of an inch or less, but when the commutator rotates, these irregularities serve as minute cams that cause the brush to vibrate rapidly in a manner such that it acts like a pump that forces air through the passageway to cool the brush holder and brush while the motor is in operation. The end of the passageway at the mouth of the bore has a smaller cross-sectional area than the part of the bore between the perforated end of the holder and that end of the brush that lies within the bore. Air is drawn into the passageway at the mouth of the bore and discharged through said perforated end of the holder. The smaller cross-sectional area at the mouth of the passageway constitutes a restriction and this, coupled with action of the brush, prevents any significant back flow of air through the passageway. Thus the flow of cooling air is substantially unidirectional.

It is a further object of the present invention to provide a brush holder and terminal clip means therefor wherein the lead or "pigtail" of the brush is connected to the clip means adjacent to the end of the brush holder remote from the mouth of the bore, and, furthermore, wherein the clip means extends outwardly of the mouth of the bore so that it may be conveniently connected to the motor field lead from which current is passed to or from the brush. This construction eliminates the need, in an all plastic brush holder, for a longitudinal slot along the brush holder in order to bring the electrical connection from the pigtail of the brush to the mouth of the brush holder. A holder

that is more durable and has greater flexibility of application is thus provided.

It is also an object of the present invention to provide a structure of the foregoing type wherein the terminal clip is firmly retained against accidental withdrawal from the brush holder.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawing forming a part thereof.

In the drawing:

FIG. 1 is a perspective view of a part of the inner clip that forms part of the present invention;

FIG. 2 is a perspective view of the contactor clip portion that cooperates with inner clip of FIG. 1 to constitute the terminal clip means of the present invention;

FIG. 3 is a top plan view of a brush holder constructed in accordance with and embodying the present invention;

FIG. 4 is a longitudinal sectional view of the brush holder assembled with a brush and the terminal clip means, and showing the assembly in mounted position in an electric motor;

FIG. 5 is a bottom plan view of the assembled holder, clip means and brush;

FIG. 6 is a fragmentary sectional view taken along line 6—6 of FIG. 4; and

FIG. 7 is a fragmentary sectional view, on an enlarged scale, taken along line 7—7 of FIG. 6.

Referring now in more detail and by reference characters to the drawing, which illustrates a preferred embodiment of the present invention, 1 designates generally a brush holder having a unitary hollow body or shell 3 that may be formed of a suitable material as, for example, a phenolic resin. The body 3 has a bore 5 opening at one end 7 thereof while the other end of the body 3 is diametrally enlarged and is formed with an end wall 9. This end wall 9 is perforated in the provision of a plurality of holes 11, thereby to provide communication with the bore 5.

Formed on the wall of the bore 5 is a plurality of axially extending sets of intersecting bearing surfaces 13 that are adapted for slidably supporting a conventional electric brush, such as carbon brush 15, within the bore 5. In the form of the invention illustrated, the brush 15 is square in cross section and there are four sets of slide-forming surfaces 13, the surfaces of each set intersecting at right angles. However, the brush 15 may be of other cross sectional shape and the bore 5 may be formed with the necessary bearing-forming surfaces of suitable shape to accommodate the particular shape of brush used. Laterally outwardly of the bearing forming surfaces 13, the bore 5 has longitudinally extending clearance passageways 17 that include enlarged slots 19. These slots 19 selectively receive terminal clip means that consists, in the present embodiment of the invention, of an inner clip 21 and a contactor clip 22.

The clips 21, 22 are each of somewhat springy sheet metal and of a width that is greater than that of the passageways 17 but less than that of the slots 19. The inner clip 21 is bowed at 23 an amount greater than the radial depth of the slots 19 so that when the inner clip 21 is inserted into any one of the slots 19, the bowed part 23 will flatten somewhat whereby the resiliency of the metal will retain the inner clip 21 in place, as best seen in FIGS. 4 and 7. Above the bowed part 23 the inner clip 21 has a hole 25 and at its upper end has a notch 27.

The contactor clip 22 is likewise bowed at 29, and the bowed part merges, at one end, into a connector eyelet 31. Struck outwardly from the convex surface of the bowed part 29 is a small protuberance 33 which, when the contactor clip 22 is inserted into a slot 19, catches

on a rib 34 that is integrally formed on body 3 in each slot 19. Each rib 34 extends across the full width of the associated slot 19 just inside the mouth of the bore 5, and projects radially inwardly an amount sufficient to prevent the contactor clip 22 from being accidentally withdrawn after it has once been inserted into the slot 19.

Also within the bore 5 is a coil spring 39 that bears at one end against the end wall 9 and at its other end against one end of the brush 15 to bias the latter outwardly of the mouth of the bore 5 and into engagement with a rotatable commutator 41 that constitutes a part of the electric motor with which the brush holder is used.

Conventionally, the commutator 41 is formed of a plurality of conducting segments 43 that are separated by suitable insulating segments 45. The brush 15 has a lead or "pigtail" 47 that is longer than the free length of the spring 39 and extends through the coil spring 39 and is secured to the inner clip 21. This is done by passing the free end of the pigtail 47 through the hole 25 and bringing said free end over the end of the clip 21 and into the notch 27. The raw edge of metal surrounding the hole 25 and at the notch 27 will retain the pigtail 47 in place.

Any suitable brush holder support, generally indicated at 49, and forming part of the motor assembly, may be used to retain the brush holder 1 in the position shown in FIG. 2. Since the brush holder 49 may be conventional, it is not shown and described in detail herein. Furthermore, a field lead 51 through which current may be supplied to the commutator 41 through the clips 21, 22, pigtail 47, and brush 15 may be secured to the eyelet 31 of the contactor clip 22.

In the assembly of the brush 15 with the holder 1 and clips 21, 22, the pigtail 47 is first secured to the inner clip 21 whereupon the brush 15 and clip 21 are inserted into the bore 5. The clip 21 may be selectively inserted into any one of the slots 19 with the clip 21 being bowed outwardly, that is, away from the brush 15. The clip 21 is shorter than the length of the slot 19 with the result that the clip 21 lies entirely within the holder 1. Thereafter the contactor clip 22 is inserted into the same slot 19 wherein the clip 21 is located, but the clip 22 will lie outwardly of the clip 21. When the clip 22 is so inserted, the protuberance 33 will ride over the rib 34 and seat thereon. This locks the clip 22 in place. The flattening out of the bowed part 29 of the clip 22 will also aid in holding the clip 22 in place. Moreover, as best seen in FIG. 7, the two clips 21, 22 overlap and their resiliency and fit within the slot 19 are such as to insure a good electrical contact between the two. The field lead 51 may thereafter be secured to the eyelet 31.

It will be seen that the foregoing provides a firm interlock between the clips 21, 22, and the holder 1, thereby constituting the clips, in effect, as one terminal clip. The clips 21, 22 provide electrical contact with the brush 15 at the end that is within the bore 5 while at the same time the electrical connection through the clips 21, 22 is brought along the bore 5 laterally of its brush 15 and outwardly of the mouth of the bore 5. The clips are free of mechanical or electrical contact with the brush 15 at its sides. Moreover, by the present invention, the holder does not have to be slotted to bring the electrical connection from the pigtail 47 to the body end 7.

The surface 53 of the commutator 41 that is pressure-engaged by the end of the brush 15 is usually full of irregularities, that is, there are variations on the surface 53 from a true, single, cylindrical surface that rotates about its longitudinal axis. As previously pointed out, these variations may be slight and they result from the assembly of the various commutator segments 43, 45.

When the commutator 41 rotates, the irregularities on the surface 53 function as minute irregular cams that cause the brush 15 to vibrate and act like the piston of a pump. As a result, air is drawn inwardly of the bore

5 at the body end 7 and passes along the bore 5 and outwardly through the holes 11, as indicated by the arrows in FIG. 1. The amplitude and frequency of vibration of the brush 15 are irregular, being determined by the characteristics of the irregularities on the surface 53. Nevertheless, the amplitude and frequency are sufficiently high that movement of the brush 15 results in an impact on the air between the inner or spring-abutting end of the brush and the end wall 9. This imparts a movement of air such that its momentum is enough that the volume of air expelled through the holes 11 is air greater than the volume displaced by the brush. The reduced pressure in the bore between the brush 15 and end wall 9 results in air being drawn into the bore 5 at the body 7 to cause the air to flow in the passageways 17. The total cross sectional area of the bore 5 at the body end 7 not occupied by the brush 15 or clips 21, 22 is substantially less than the total unoccupied cross-sectional area of the part of the bore that is between the spring abutting end of the spring 39 and the end wall 9, it being seen that the spring 39 and clip 21 occupy only a small part of the bore at that region thereof. Return movement of the brush 15 toward the commutator 41 is under the action of the spring 39. This return movement is determined by the force of the spring 39 while movement in the opposite or "pumping" direction is controlled by the driving forces of the cam-like surface irregularities. The large number of irregularities on the surface 53 and the speed of rotation of the commutator is ordinarily such that the cammed movement of the brush 15 in the pumping direction is much faster than the movement in the return direction. The somewhat slower return movement of the brush 15 cannot create enough back pressure to force any significant amount of air through the restricted space constituted by the passageways 17 at the mouth of the bore 5. This effectively prevents back flow of air through the brush holder.

As long as the motor is in operation, there will be a substantially unidirectional flow of cooling air through the brush holder to cool both the holder and the brush. This reduces the temperature of the holder from what it might otherwise be, and accordingly, increases the capacity of the brush holder and assists in prolonging its useful life.

In compliance with the requirements of the patent statutes I have herein shown and described a preferred embodiment of the invention. It is, however, to be understood that the invention is not limited to the precise construction herein shown, the same being merely illustrative of the principles of the invention. What is considered new and sought to be secured by Letters Patent is:

1. An electrical brush holder comprising a body having a bore provided with longitudinally extending slide-forming means for slidably receiving an electrical brush and confining same to reciprocating movement, said bore being open at one end and through which the brush may be inserted thereinto with the brush projecting outwardly of the bore at said one end thereof and with the brush being spaced from the other end of the bore, said body being perforated at its other end to provide an opening therethrough in communication with the bore, the cross-sectional area of the bore being substantially greater than the cross-sectional area that is to be occupied by the brush so as to form a passageway from said one end of the bore to the opening at the other end thereof, the passageway having cross-sectional areas such that vibratory movement of a brush in the bore constitutes a pump that creates a flow of air through the pasageway from one end of the bore to the other.

2. An elecctrical brush holder comprising a unitary dielectric shell having a longitudinal bore opening at one end of the shell and having longitudinal slide-forming means for slidably receiving an electrical brush that has a cross-sectional area substantially less than the cross-sectional area of the bore so that when a brush is within

the bore, the space unoccupied by the brush provides a longitudinal passageway from said one end of the bore to the other end thereof, said shell having an end wall at said other end of the bore, the end wall being perforated to provide communication with the bore.

3. An electrical brush holder comprising a unitary dielectric shell having a longitudinal bore opening at one end of the shell and having longitudinal slide-forming means for slidably receiving an electrical brush that has a cross-sectional area substantially less than the cross-sectional area of the bore so that when a brush is within the bore, the space unoccupied by the brush provides a longitudinal passageway from said one end of the bore to the other end thereof, the opposite end of the shell being open to provide communication with the bore, the passageway also including a terminal clip-receiving slot that extends from the open end of the bore in spaced relationship to the slide-forming means.

4. In combination, an electrical brush holder comprising a unitary dielectric shell having a longitudinal bore opening at one end of the shell and having means for slidably receiving an electrical brush, terminal clip means having means remote from said one end of the shell for making electrical contact with a brush assembly that is within the bore, said terminal clip means extending longitudinally within the bore and projecting outwardly of said one end of the shell and having electrical contact-forming means on the outwardly projected part, said shell also having means for securing the terminal clip means in a manner to maintain the part thereof that extends longitudinally within the bore out of contact with a brush that is within the bore.

5. In combination, an electrical brush holder comprising a body having an opening therethrough, an electrical brush mounted in the opening for reciprocating movement therein and being of such size and shape relative to the opening as to provide an air-flow passageway from one end of the opening to its other end, a part of the brush projecting outwardly of the body and adapted for engagement with a rotating commutator, whereby irregularities in the contacted portion of the commutator causes the brush to vibrate and induce a flow of cooling air through the body.

6. In combination, an electrical brush holder comprising a body, an electrical brush mounted in the body for reciprocating movement therein and projecting outwardly from the body and adapted for engagement with a rotating commutator, and resilient means for biasing the brush in a direction to maintain the brush in pressure engagement with the commutator, said body and brush cooperating to provide a passageway extending through the body, the vibratory movement of the brush due to irregularities in the contacted portion of the commutator constituting a pump that induces a flow of cooling air through the passageway.

7. In combination, an electrical brush holder comprising a unitary dielectric shell, an electrical brush mounted in the shell for reciprocating movement therein and projecting outwardly from one end of the shell and adapted for engagement with a rotating commutator, and resilient means for biasing the brush in a direction toward said one end of the shell to maintain the brush in pressure engagement with the commutator, said brush and shell cooperating to provide a passageway extending through the shell lengthwise thereof, the vibratory movement of the brush due to irregularities in the contacted portion of the commutator constituting a pump that induces a flow of cooling air through the passageway, the passageway having cross-sectional areas such that the flow of cooling air is substantially unidirectional from said end of the passageway near the projected end of the brush to said other end of the passageway.

8. In combination, an electrical brush holder comprising a body having a bore, an elecrical brush mounted in the bore for reciprocating movement therein and projecting from the bore at one end thereof and adapted for engagement with a rotating commutator, and resilient means in the bore for biasing the brush toward said one end to maintain the brush in pressure engagement with the commutator, said brush having a substantially smaller cross-sectional area than that of the bore and the body being perforated adjacent to said other end of the bore thereby to provide a passageway through the body and from one end of the bore to the other, the vibratory movement of the brush due to irregularities in the contacted portion of the commutator constituting a pump that induces a flow of air through the passageway.

9. In combination, an electrical brush and a holder therefor, said holder comprising a unitary plastic shell having a bore provided with longitudinally extending slide-forming means for receiving the brush and confining same to reciprocating movement, said bore being open at one end and one end of the brush projecting outwardly of the bore at said open end and being adapted for engagement with a rotating commutator, the other end of the brush being spaced from the other end of the bore, spring means interposed between said other end of the brush and said other end of the bore for biasing the brush in a direction toward said one end of the bore to maintain the brush in pressure engagement with the commutator, said shell being perforated at said other end thereof to provide an opening therethrough in communication with the bore, the cross-sectional area of the bore being substantially greater than the cross-sectional area of the part of the brush therein so as to form a passageway from said one end of the bore to the opening at the other end thereof, the cross-sectional area of the passageway at said one end of the bore being substantially less than the cross-sectional area of the unoccupied part of the bore between the brush and perforated end of the shell so that vibratory movement of the brush due to irregularities in the contacted part of the commutator constitutes a pump that induces a substantially unidirectional flow of air through the passageway from said one end of the bore to the other end thereof and through said opening.

10. In combination, an electrical brush holder comprising a body, an electrical brush slidably mounted in the body for reciprocating movement therein and having one end projecting outwardly from an adjacent end of the body and adapted for engagement with a rotating commutator, resilient means for biasing the brush in a direction toward the outwardly projected end of the brush to maintain the brush in pressure engagement with the commutator, said body having an end thereof within the body, said body and brush cooperating to provide a passageway extending through the body, the vibratory movement of the brush due to irregularities in the surface of the commutator constituting a pump that induces a flow of air through the passageway, and electrically conductive terminal clip means in said body and having contact-forming means within said body, means forming an electrical circuit from the end of the brush that is within the body to said contact-forming means, said terminal clip means being otherwise out of electrical contact with the brush and projecting outwardly from the body at said one end thereof.

11. In combination, an electrical brush holder comprising a dielectric body, an electrical brush slidably mounted in the body for reciprocating movement therein and having one end projecting outwardly from an adjacent end of the body and adapted for engagement with a commutator, said body having an end thereof within the body, resilient means for biasing the brush in a direction toward the outwardly projected end of the brush to maintain the brush in pressure engagement with the commutator, and electrically conductive terminal clip means in said body and having contact forming means within the body, means forming an electrical circuit from the end of the brush that is within the body to said contact-forming means,

said terminal clip being otherwise out of electrical contact with the brush and projecting outwardly from the body at said one end thereof.

12. In combination, an electrical brush holder comprising a plastic body, an electrical brush slidably mounted in the body for reciprocating movement therein and having one end projecting outwardly from one end of the body and adapted for engagement with a rotating commutator, resilient means for biasing the brush in a direction toward the outwardly projected end of the brush to maintain the brush in pressure engagement with the commutator, the body having an end opposite said one end thereof and in spaced relation to the opposite end of the brush, and electrically conductive terminal clip means in said body and having contact-forming means adjacent to said opposite end of the body, means forming an electrical circuit from said opposite end of the brush to said contact-forming means, said terminal clip being otherwise out of electrical contact with the brush and having a part thereof extending lengthwise of the body adjacent to the brush and projecting outwardly from the body at said one end thereof, said body having means for maintaining the lengthwise extending part of the clip in spaced relation to the brush.

13. In combination, an electrical brush holder comprising a dielectric body, an electrical brush slidably mounted in said body and projecting outwardly from one end thereof, said brush having an end thereof within the body, a lead wire extending from that end of the brush that is within the body, and terminal clip means within the body and projecting outwardly from said one end thereof adjacent to the outwardly projected end of the brush, said lead wire making an electrical contact with a part of the terminal clip means that is within the body.

14. In combination, an electrical brush holder comprising a body, an electrical brush slidably mounted in said body and projecting outwardly from one end thereof, said brush having an end thereof within the body, a lead wire extending from that end of the brush that is within the body, terminal clip means within the body and projecting outwardly from said one end thereof adjacent to the outwardly projected end of the brush, said lead wire making an electrical contact with a part of the terminal clip means that is within the body, and means for maintaining the terminal clip means in spaced relation to the brush.

15. In combination, an electrical brush holder comprising a dielectric body, an electrical brush slidably mounted in said body and projecting outwardly from one end thereof, said brush having an end thereof within the body, a lead wire extending from that end of the brush that is within the body, said body having an internal slot laterally spaced from the brush, terminal clip means within the slot and cooperating with the part of the body that forms the slot for retaining the clip within the slot, said clip means projecting outwardly of the slot at said one end of the body, and means on the part of the clip means within the body for making an electrical connection with the lead wire.

16. The combination according to claim 15 wherein the clip means comprises an inner clip that lies wholly within the body and makes the electrical connection with the lead wire, and a contactor clip that makes electrical contact with the inner clip and projects outwardly from the body.

17. The combination according to claim 16 wherein each clip is resilient and is bowed at a part thereof, the bowed parts being partially flattened by the part of the body that forms the slot to cooperate therewith and hold the clips in the slot.

18. The combination according to claim 16 wherein the contactor clip has a protuberance that catches on a rib that is integrally formed on the body in the slot adjacent to said one thereof for mechanically locking the contactor clip against retraction from the slot.

19. In combination, an electrical brush holder comprising a one piece plastic body having an axial bore opening at one end of the body for receiving an electrical brush, said body also having an internal axially extending slot opening at said one end of the body and being radially spaced from the part of the bore that is adapted to be occupied by the brush, a clip mounted in said slot and projecting outwardly from said one end of the body, cooperating means in the body and on the clip for preventing radial movement of the clip, and cooperating projections on the clip and in the slot for preventing accidental retraction of the clip from the slot once the clip has been inserted into the slot.

20. In combination, an electrical brush holder comprising a dielectric shell having a bore opening at one end of the shell, an electrical brush mounted in the bore and having one end thereof projecting outwardly from the shell at said one end thereof, the other end of the brush lying within the bore, and electrically conductive means in mechanical and electrical connection with the end of the brush that lies within the bore, said means extending along the bore out of mechanical and electrical contact with the brush and outwardly of the bore at said one end of the shell.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,171,050 February 23, 1965

James Gordon

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 69, for "pasageway" read -- passageway --; column 8, line 22, after "one" insert -- end --.

Signed and sealed this 3rd day of August 1965.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

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