W. J. WARDER, JR.

BRUSH HOLDER.

APPLICATION FILED JAN. 17, 1918.

1,375,124. **Patented Apr. 19, 1921.**

Fig. 1.

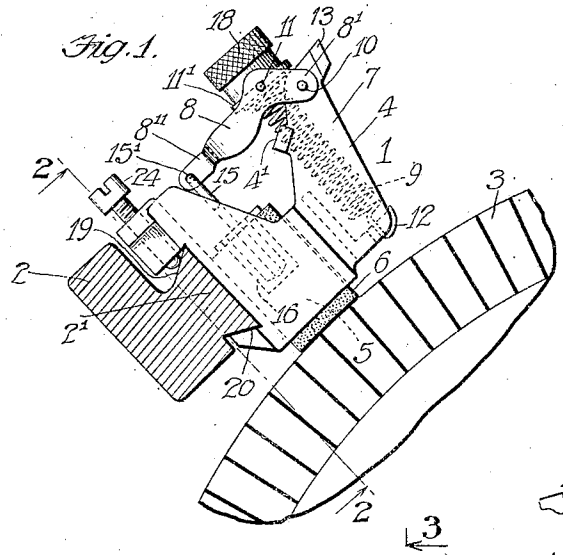


Fig. 7.

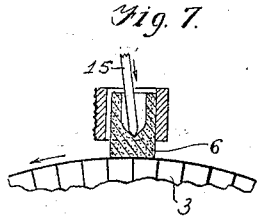


Fig. 2.

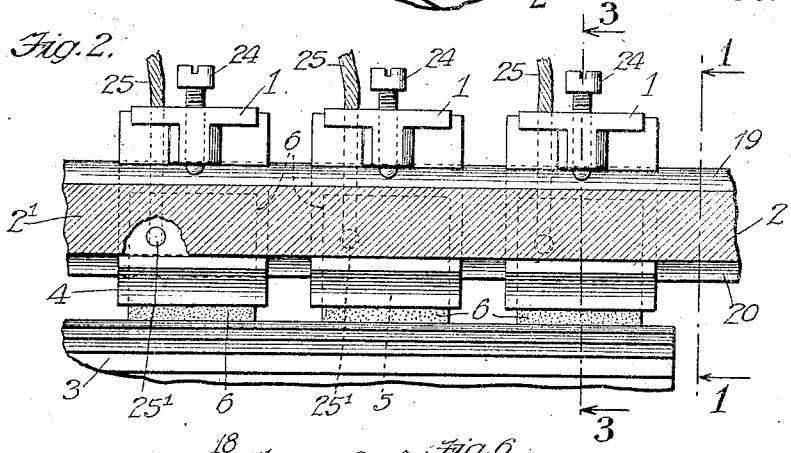


Fig. 3.

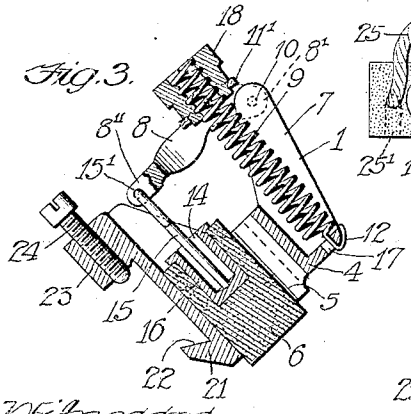


Fig. 6.

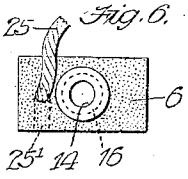


Fig. 4.

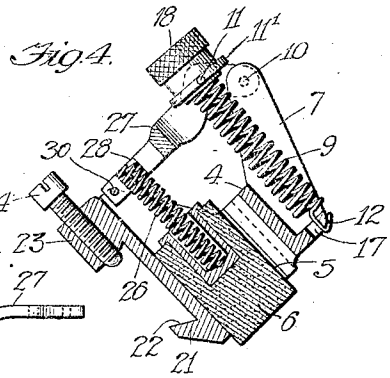
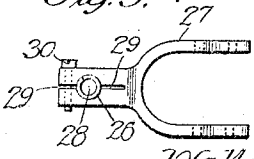


Fig. 5.



Witnesses

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UNITED STATES PATENT OFFICE.

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BRUSH-HOLDER.

1,375,124. Specification of Letters Patent. Patented Apr. 19, 1921.

Application filed January 17, 1918. Serial No. 212,220.

To all whom it may concern:

Be it known that I, WALTER J. WARDER, Jr., a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Brush-Holders, of which the following is a specification.

This invention relates to brush holders for dynamo-electric machines, and especially to brush supporting devices adapted for holding a hard solid brush somewhat loosely and yieldingly, and particularly to those features of construction and arrangement of brush holder parts which determine the precise position and operation of the brush with respect to the face of the commutator, and which are intended to insure its effective contact therewith.

The main objects of this invention are to provide a self-righting brush and brush holder; to provide in a brush holder an improved form of means for applying to the brush the inwardly directed elastic force necessary for positively maintaining a well defined unvarying contact with the commutator throughout the whole area of the current collecting face or end of the brush; to provide an improved form of brush and means for applying yielding pressure thereto adjacent to its active face for pressing the brush tightly and uniformly against the commutator in non-vibrating relation thereto; to provide a brush holder adapted to insure a substantially radial position of the brush with uniform end contact on the commutator regardless of the direction of armature rotation; and to provide for a brush surface of extra large area, for the size of brush exposed to the air for radiating such heat as may be developed therein.

An illustrative embodiment of this invention is shown in the accompanying drawings, in which:

Figure 1 is a side elevation of the brush holder disposed in its normal working relation with respect to the commutator, only a fragment of the latter being shown, and the brush holder stud being in cross-section on the line 1—1 of Fig. 2.

Fig. 2 is a side view of a plurality of brush holders disposed in working relation to the commutator, and a part of the supporting stud being shown in section on the line 2—2 of Fig. 1.

Fig. 3 is a section of a brush holder on the line 3—3 of Fig. 2.

Fig. 4 is a sectional view of a brush holder having a modified form of lever and thrust member, the section being taken substantially as in Fig. 3.

Fig. 5 is a plan of the modified form of lever shown in Fig. 4.

Fig. 6 is a top view of one of the brushes.

Fig. 7 shows a brush and brush holder in section and illustrates how the pressure pin may be inclined so as to overcome friction and thus hold the brush against the leading side of the holder.

In the form of embodiment shown in Figs. 1, 2, and 3, the brush holders 1, of a given group corresponding with a certain angular position, are secured to a supporting stud 2 of rigid character, which is mounted stationarily, as understood in the art. Said stud is disposed adjacent to the face of the commutator 3 and in suitably spaced relation thereto and parallel to the axis thereof.

Each brush holder comprises a body part or frame 4 having suitable means hereinafter described for securing same demountably on the stud 2, the latter being correspondingly formed to facilitate such attachment. Said frame 4 is formed with a tubular part having an aperture 5 for the brush 6. The main axis of the aperture 5 when the brush holder is mounted on its stud 2, is disposed in a direction approximately radial with respect to the commutator axis, so that the brushes all stand in a substantially radial position.

An arm or bracket 7 is provided on said frame 4, and on said arm is mounted a lever 8 and resilient means 9 for urging the lever to an effective position for securing the brush 6, as will be described. When the brush holders have been duly mounted in suitable groups on their respective studs, the brushes 6 are mounted one in each of the apertures 5, and each brush is secured yieldingly in place by the corresponding lever 8 and spring 9.

Said lever 8 comprises a short arm 8′ and a long arm 8″. The outer end of the short arm is pivoted at 10 to the outer end of the

bracket 7. A medial pivot axis is provided at 11 where the two said arms meet and at which point the spring 9 is attached. The opposite end of said spring is attached to the frame 4 at 12, adjacent to the base of the bracket 7. Said arms are preferably inclined at an angle to each other, so that when the lever is tipped through a relatively small angle, about 60° rather than 100°, the pivot axis 11 will swing slightly past pivot 10, with a snap-over action as will be understood, and the lever will seat stably against shoulder 13 on said arm. The said lever and bracket are correspondingly forked to receive the helical tension spring 9 between their arms.

In order that the brush 6 may be self-righting with respect to the commutator face, the pressure of the lever 8 is applied thereto at a point relatively near the bearing face of the brush, preferably near the center thereof. For this purpose the brush is apertured at its outer end, and a pressure transmitting member 15 stands therein, the opening 14 preferably being cylindrical and extending toward the face which fits against the commutator. It may well extend approximately half the length of the brush, the solid end of the brush being adapted to provide amply for wear and consequent shortening of the brush.

The brush is preferably provided with a cup-shaped lining member 16 adapted to fit the opening 14. The bottom of the cup 16 may to advantage be deepest at the center, and to this end may be conical so as to direct the member 15 automatically toward the center of the brush bearing face.

The said thrust member or plunger 15, which is provided on the lever for communicating its inwardly directed force to the brush, is preferably in the form of a rigid rod pivotally connected to the lever as at 15′, the opposite end being free to bear in the apex of the cup 16.

The spring 9 is formed at its lower inner end with a hook-part at 12 adapted to enter the perforation at 17 and engage the adjacent frame part. The opposite outer end of the spring is provided with adjusting means for varying the tension of the spring in accordance with the shape of the brush and the degree of the tension required. For this purpose the pivot member 11 is ring-shaped with a trunnion on each side of the ring part 11′ for fitting in the pivot bearings provided in the branches of the bifurcated lever 8. A threaded nut-like member 18 is provided, which is adapted to seat rotatably on the ring 11′, said nut member 18 being adapted to receive the outer end of the helical spring, the turns of which are adapted to coincide with and fit in the threads of the nut. By this means the tension of the spring may be varied by turning the nut member with respect to the spring. As the brush wears away the spring may be tightened by screwing farther into the nut 18.

In order to limit the inward movement of the lever 8 and the plunger 15 carried thereby, a shoulder 4′ is provided on the inner side of the bracket 4 in the path of said lever. The parts are so proportioned that when the brush becomes worn away nearly to the bottom of the aperture 14, the lever 8 will be arrested by the shoulder 4′, whereupon the brush must be replaced by a new or longer one.

Means are provided for mounting the brush holder adjustably on the stud 2. For this purpose the stud is provided with a lateral rib 2′ having oppositely flaring sides 19 and 20 upper and lower respectively. The frame 4 is provided with spaced clamping means on its support engaging side, comprising a jaw 21 having an inclined face 22 corresponding with the coacting face of said rib, and a perforated shoulder 23 threaded interiorly and provided with a screw 24 adapted to coact with the opposite face of said rib. When the brush holder is applied to the stud, and the said screw 24 is set tightly against the rib face 19, the brush holder is held snugly in place thereby. If it becomes desirable to move the brush holder laterally in either direction, same may be accomplished by loosening the said screw, and then after the brush holder and brush have been placed in their new position the set screw may be tightened or set as before.

The above described means for mounting the brush holder on the stud 2 is claimed in my copending application Serial No. 212,221 filed on the 17th day of January 1918.

In order that the loose contact between the brush and its holder need not be relied upon for carrying the current, each brush 6 is provided with a fine wire cable or "pig tail" 25, one end of which is set in the brush, as shown at 25′ in Fig. 2, and the other end being connected to the brush holder, as understood in the art.

In the embodiment shown in Fig. 4, the plunger for communicating the pressure of the lever to the brush is in the form of a flexible member, namely a spiral compression spring 26 clamped to the free end of the modified lever 27. This provides a somewhat more unitary character to the brush-urging means, and has corresponding advantages over the form shown in Fig. 3. The lever 27 differs from lever 8 in the construction of the free end which is perforated at 28, and split at 29 to receive the spring 26, and is provided with a locking screw 30 adapted for setting to clamp the sides of the split arm against said spring. Otherwise the lever 27 is like lever 8.

It is to be noted that with the above de-

scribed embodiments of this invention, the brushes may be of the usual size and length, the brush-holder frames may be of the usual form and construction, and the jumpers for the brushes may be connected in the usual way. By the novel construction shown, however, the pressure of the spring is applied to the brush at a point near the center, so that it produces a certain relation between the brush width, friction with the commutator, pressure on the brush, and the distance from the point of application of the pressure to the commutating surface, whereby the tendency of the brush to tip is overcome and the brush is caused to ride stably in upright position on the face of the commutator.

By reason of my improvement, it is practicable to use a very thin brush adapted for self-righting. A plurality of these brushes may be alined at the several points of commutation sufficient to provide the necessary current capacity, and the small arc of contact makes for sparkless operation. The deeper the brush cup the thinner the brush may be given for a given degree of self-righting stability (see Figs. 6 and 7).

With ordinary brushes, in case the brush is removed temporarily for any reason, it is usually necessary to replace the brush in exactly the same position, in order that it may continue to set squarely on the commutator surface, but with this improved form of brush a true and complete bearing is assured regardless of how the brush is replaced. Furthermore, with ordinary brushes, reversal of the direction of rotation of the armature usually causes a slight change in the position or tilting of the brushes, whereby the bearing is shifted mainly or wholly to one edge, but with the improved form of brush the bearing is unaffected by reversal of rotation for the reason that the inward force of the retaining spring is applied relatively near the contact surface and midway between the leading and trailing edges of the contact area of the brush.

Now if we consider a reversible machine, such as an elevator motor or a railway motor, we find that with ordinary holders the brush tips one way for one direction of rotation, and the other way for the other direction of rotation, and that there are two contact surfaces worn on the brush, each on the trailing edge for the corresponding direction of rotation respectively. Thus the brush tends constantly to ride on one or the other of the edges. This tends to make the operating condition very unsatisfactory, and there is usually considerable chattering and vibration. This also causes the brushes to wear out rapidly.

There have been numerous attempts to make the ordinary brush fit the usual holder tightly, so that the amount of tipping would be small, but this leads to several difficulties. Dirt gets in, and then the brushes frequently stick in the holders and fail to operate. The tipping of the brush or the use of a tight holder increases the losses on the commutator. The brush will not move downward with as much pressure as is required to cause it to move upward. There are frequently inevitable variations in the commutator surface, which makes it an imperfect cylinder. Thus the brush is caused to move up and down in the holder. When an uphill portion of the commutator surface is approaching the brush the pressure is excessive. When a downhill portion is moving under the brush the pressure is too light. In the first case the friction is too high, and in the second case the electrical losses due to resistance are too high. This results in excessive heating.

The action of the self-righting holder overcomes these difficulties and is highly efficient and reliable in practical work, even where the conditions of service and commutator surface are not favorable. On a reversible machine the usual tilting or rocking of the brush incident to back-lash is avoided and the contact surface for both directions of rotation is absolutely the same and there is but one commutator bearing surface on the brush. There may be considerable clearance between the holder and the leading face and also at the sides of the brush. There is no tendency to tip. The brush may be observed to move bodily through a small arc about the commutator from one side of the holder box to the other when the direction of rotation is changed.

In practice it has been observed, in the case of some very heavy metal-graphite brushes located in a horizontal direction, that the weight of the brushes happened to be equal to the friction on the upwardly moving side of the commutator, and when small changes occurred one or more of the brushes would move in a vertical direction as the balance between these two forces changed slightly, without any tilting or shifting of its bearing on the commutator as would occur with ordinary brush holders.

In cases where brushes have been sandpapered to fit them to the curvature of the commutator, the friction with the sandpaper is so very high as to disturb the relation which results in the self-righting feature. This invariably results in two slightly eccentric arc surfaces being sanded on the brush. When a brush so sanded is put into use on a reversible machine, it will tip from side to side upon reversal of rotation, and will have two contact surfaces the same as an ordinary outfit gives, but within a week or two of service the self-righting feature will have asserted itself and the brush will then be found to have worn to only one con-

tact surface. This proves the self-righting feature to be of such magnitude as to inherently assert itself when the conditions of installation have been such as to prevent it predominating in the beginning.

A great deal of trouble results from a brush holder of usual form which is relatively unsatisfactory for the reverse direction, and much trouble is found when it is necessary to change the assembly of the brush rigging to accommodate turning the brush holders around for the new direction of rotation.

It will thus be seen that with the self-righting holder a condition of equilibrium is maintained at the contact surface of the brush, whereby the contact surface is maintained in constant stable relation to the commutator by the forces involved in the pressure and friction.

With all other types of holders the contact surface is held to a greater or less degree of excellence by external means, such as the box of the holder, and is not primarily dependent upon the pressure itself, the point of application, the coefficient of friction, and the angles through which these forces act, these angles being dependent to a considerable extent upon the distance between the commutator face and the point of application relative to the thickness of the brush.

One of the great advantages of self-righting holders has been a reduction in noise. The brushes do not chatter and do not make the disturbing noise experienced with ordinary brushes which tip over and present a sharp edge to the approaching mica insulation between the segments. In the past, soft brushes have been used in order to keep down the noise, the harder grades of brushes being used only in places where noise suppression is unimportant. With the self-righting holder hard brushes may be used without noise. Thus the life of the brush is greatly increased.

In the case of some machines of one direction of rotation, there is advantage in applying the pressure in a direction which is slightly at an angle with the axis of the brush and with the radius of the commutator which passes through the center line of the brush, one component of the pressure being opposite to the direction of rotation. This is for the purpose of causing the brush to stay over at one side of the box, and to press lightly against that side of the box which is opposite what would ordinarily be the non-contact or light side face of the brush. (See Fig. 7). This action is relatively small, so that the friction of the brush is a minimum in moving up and down as an out-of-true commutator moves under it.

It will be seen that the radial friction of the brush when one side only slides up against the side of the box will be much less than when a brush is tilted in a box in the ordinary way. In this case the friction mentioned is that of the brush as it moves in and out of the holder due to an out-of-true commutator.

Although but two specific embodiments of this invention are herein shown and described, it will be understood that numerous details of the construction shown may be altered or omitted without departing from the spirit of this invention as defined by the following claims.

I claim:

1. In a device of the character described, a brush holder for dynamo-electric machines, a ventilated hollow brush fitting loosely therein, a lever pivoted to the frame of the brush holder, means for urging the lever inwardly toward said brush, and a plunger connected at its outer end to said lever in substantially free and unconstrained swinging relation thereto, said brush having a deep outwardly facing central recess, and said plunger at its inner end being disposed to bear against said brush at the inner end of said recess.

2. A self-righting brush holder, a brush therefor, and yielding means to apply inward pressure to the brush adjacent to the commutator bearing face, said means being formed and arranged to apply a relatively small component of its pressure in a tangential direction opposite from the direction of rotation, said brush having an outwardly facing bearing part near its commutator end to receive said pressure, and said means being disposed to act diagonally inward and against rotation.

Signed at Chicago this 4th day of Jan., 1918.

WALTER J. WARDER, JR.