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2,389,941

BRUSH RIGGING

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Fig. 1.

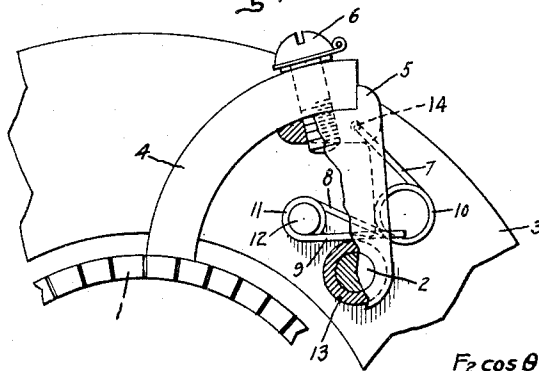


Fig. 2.

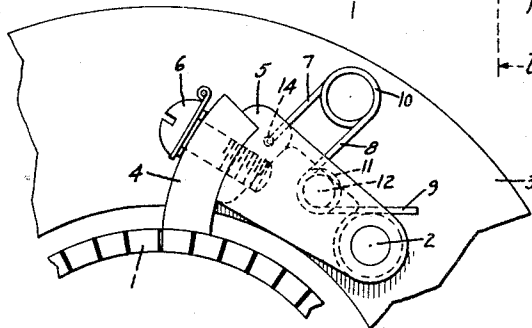
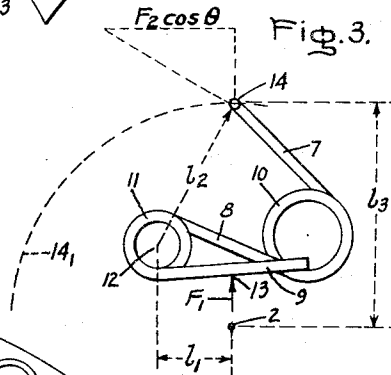
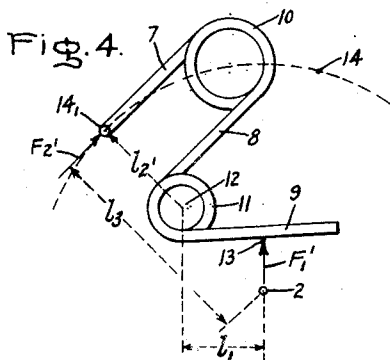


Fig. 3.



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BRUSH RIGGING

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7 Claims. (Cl. 171—324)

My invention relates to brush riggings and is particularly directed to a brush holder adapted to support an arcuate brush and to provide a substantially constant biasing force on the brush for maintaining substantially constant brush pressure on a current collector.

An object of my invention is to provide an improved brush rigging for dynamoelectric machines.

Another object of my invention is to provide an improved pivotally mounted brush rigging which provides substantially constant brush pressure between the brush and a current collector.

Further objects and advantages of my invention will become apparent and my invention will be better understood from the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

In the drawing, Fig. 1 is a side elevational view, partly broken away, showing an embodiment of my invention with a relatively long brush secured to the brush holder; Fig. 2 is a side elevational view of the construction shown in Fig. 1 in which the brush is relatively short or worn out; Fig. 3 is a schematic representation of the construction shown in Figs. 1 and 2 in which a relatively long brush is considered as secured to the brush holder, similar to that shown in Fig. 1; and Fig. 4 is another schematic view similar to that of Fig. 3 in which a relatively short brush, such as is shown in Fig. 2, is considered as mounted on the brush holder. These latter two figures are used to show the various forces and moments to be considered in an analysis of the functioning of this brush holder.

In most rotating electrical machinery, some provision must be made for the transfer of current between a stationary terminal and a relatively rotatable conductor in order to connect the rotatable conductor to an external electrical circuit when the rotatable member is in operation. In most instances, this is formed by some type of brush mounted on a brush holder which is biased towards a current collector by some resilient construction. In most practical constructions, the brush which provides the contact between the rotatable conductor and the stationary terminal is formed of a material which wears out in time, such that the force on the brush by the resilient biasing means varies from a maximum when the brush is new to a minimum when the brush is old and worn out. Furthermore, in most

instances, it will be found that the best operation of the current collector and brush is obtained at a predetermined pressure of the brush on the current collector. However, since this pressure varies from a maximum to a minimum as the brush wears, it is necessary to compromise the pressure of the brush on the current collector by making this pressure somewhat higher when the brush is new and permitting the pressure to decrease to a value somewhat below the most desirable value when the brush is worn out. Various constructions have been proposed for minimizing this range of pressure of the brush on the current collector, however, in most instances, a further improvement of this variable brush pressure is desirable.

Referring to the drawing, I have shown my invention as applied to brush riggings adapted to be used in connection with a dynamoelectric machine in which current is adapted to be transferred from a rotatable current collector, shown as a commutator 1, to a relatively stationary terminal connected to a stationary pivotal mounting pin 2, which is supported on a stationary mounting ring 3. The brush rigging in this construction includes a brush holder which is adapted to hold an arcuate brush 4 having a curvature formed on a center, corresponding substantially to the center of the supporting arm pivotal mounting pin 2, to the point of support of the brush 4 on the brush holder arm. The arcuate brush 4 is mounted on a supporting arm 5, which is pivotally mounted about the relatively stationary pivot pin 2, at a point spaced away from the brush 4. In the illustration, the brush 4 and a pivot pin 2 are mounted on opposite ends of the supporting arm 5, and the brush is secured to the end of the supporting arm by a suitable screw 6 which passes through the brush and threadedly engages a complementary threaded opening in the end of the supporting arm 5. In order to bias the brush 4 into contact with the commutator 1 at the predetermined most desirable pressure, a resilient Z-shaped spring is arranged to provide a substantially constant pressure on the brush for different positions of the brush supporting arm 5 within a predetermined range of motion which corresponds to the positions of the supporting arm 5 from a new and long brush position to an old or worn-out brush position. This Z-shaped spring is formed with three interconnected fingers 7, 8, and 9 which are joined together at the two joints by coiled spring sections 10 and 11, thereby forming two unconnected end fingers 7 and 9 with an interconnect-

ing finger 8 extending between the two coiled portions 10 and 11. One of the coiled spring portions 11 which interconnects the fingers 8 and 9 is loosely pivotally mounted about a relatively fixed point formed by a pin 12, which is secured to the mounting ring 3, with the unconnected end finger 9 thereof biased against a relatively fixed spring stop 13 which is mounted on the supporting arm pivot pin 2. The unconnected end 14 of the third finger 7 of the spring is arranged in engagement with the brush supporting arm at a substantially fixed point thereon and extends into an opening in the supporting arm 5. In this position, the ends of the spring are biased towards each other for compressing the spring and thereby biasing the brush 4 towards the current collector 1. As shown in Fig. 1, the fingers 7 and 8 are relatively far apart when a new brush is mounted on the brush holder, and the fingers 8 and 9 are relatively close together and compressed towards each other with the major portion of the spring stress in the coiled spring portion 11, while when a short brush is on the supporting arm 5, as shown in Fig. 2, the fingers 7 and 8 are relatively close together and the fingers 8 and 9 are relatively farther apart, such that the major portion of the spring stress is in the coiled spring portion 10. The pin 12 is of a length such that it will engage the underside of the top of the arm 5 in this position and act as a stop to prevent further movement of the brush towards the commutator. The Z-shaped spring could be formed without the coiled portions 10 and 11 providing that there be properly bent joints between the three fingers of the spring.

In order to utilize the change in stress between the spring portions which interconnect the three fingers of the Z-spring, the moment acting on the parts of this construction must be such as to maintain the force on the brush 4 substantially constant. A consideration of Figs. 3 and 4 will show how this is possible by a proper proportioning of the different fixed and pivotal points of the brush rigging. In the diagram, the points 2, 12, and 14 correspond to the pivot pins 2 and 12 and the point of attachment of the spring end 14 to the brush supporting arm 5. Since the maintenance of the spring pressure at the point 14 at a constant value necessarily results in the maintenance of a constant spring pressure on the brush 4, this point has been chosen, as it is directly secured to the spring. The distance indicated by the reference numeral l_1 is the fixed distance between the pivot pins 2 and 12, the distance l_2 is the variable moment arm from the pivot pin 12 to the end 14 of the spring, and the length l_3 is the fixed moment arm between the pivot pin center 2 and the point of attachment of the end 14 of the spring to the brush supporting arm 5. The forces exerted by the spring at various points are designated by arrows and the letter "F." F_1 represents the force exerted by the connected spring finger 9 on the fixed spring stop 13. The force F_2 represents the force transmitted by the end 14 of the spring to the brush supporting arm 5. The prime of any of the letters "l" or "F" indicates the values which obtain when the brush is short or worn, as shown in Fig. 2 and represented schematically in Fig. 4. Referring to Fig. 3, the summation of moments about the point 12 is given by the equation

$$F_1 l_1 = F_2 l_2$$

Furthermore, the brush pressure in this figure corresponds to $F_2 \cos \theta$, which is the tangent to

the arc 14—14₁ at a radius l_3 from the pivot point 2. Thus, the value of the pressure on the brush is

$$F_2 \cos \theta = F_1 \frac{l_1}{l_2} \cos \theta$$

A consideration of the moment about the same pivot point 12 for a worn brush or a short brush may be made by reference to Fig. 4. In this figure, the brush is considered as having worn to a minimum value wherein the force of the spring finger 7 on the brush acts substantially tangentially to the arc of the brush, as represented by the arc 14—14₁. The equation for the moment in this figure about the spring stop pivot point 12 may be expressed as follows:

$$F_1' l_1 = F_2' l_2'$$

The brush pressure in this arrangement then corresponds to

$$F_2' = F_1' \frac{l_1}{l_2'}$$

For a condition where the brush pressure is the same with a new and worn brush the equation for brush pressure for Figs. 3 and 4 must be equal; that is

$$F_2 \cos \theta = F_2'$$

or

$$F_1 \frac{l_1}{l_2} \cos \theta = F_1' \frac{l_1}{l_2'}$$

or this expression may be changed to read as follows:

$$\frac{F_1}{F_1'} \cos \theta = \frac{l_2}{l_2'}$$

As the brush wears, the initial F_1 decreases to some smaller value F_1' , and simultaneously the lever arm l_2 decreases to some smaller value l_2' . By locating the pivots 2 and 12, and the points 13 and 14, such that the spring forces and the lever arms vary in the correct respective proportion, essentially constant brush pressure can be maintained on the brush as it wears. This relationship may be obtained by varying the pivot points 12 and 13 for the spring and the brush-holder arm pivot point 2. Thus, in the illustrated construction for the given spring, the fixed spring pivotal mounting pin 12 is located relative to the spring engagement point 14 on the brush supporting arm 5, such that the distance therebetween varies with movement of the supporting arm directly with the variation of the spring pressure of the unconnected spring finger 9 on the fixed spring stop 13 on the supporting arm pivot pin 2 for different positions of the brush supporting arm within the predetermined useful range of motion of this arm from a new to a used brush position for maintaining the pressure on the brush substantially constant throughout this range of motion. In this manner, a relatively simple and inexpensive brush rigging for maintaining a substantially constant brush pressure is provided.

While I have illustrated and described a particular embodiment of my invention, modifications thereof will occur to those skilled in the art. I desire it to be understood, therefore, that my invention is not to be limited to the particular arrangement disclosed, and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A brush rigging including a supporting arm adapted to hold an arcuate brush, means for pivotally mounting said supporting arm at a point spaced away from said brush, a relatively fixed spring stop, and means including a substantially Z-shaped spring with the joint between two of the connected fingers of the spring pivotally mounted about a relatively fixed point with the unconnected end finger thereof biased against said relatively fixed spring stop and with the unconnected end of the third finger of said spring arranged in engagement with said brush supporting arm at a substantially fixed point thereon maintaining a fixed spring finger length for said third finger for biasing said brush towards a current collector, said fixed spring pivotal mounting point being located relative to said spring engagement point on said brush supporting arm such that the distance therebetween varies directly with the variation of spring pressure of said first-mentioned spring finger on said fixed spring stop for different positions of said brush supporting arm within a predetermined range of pivotal motion for maintaining the pressure on the brush substantially constant in the predetermined range of motion.

2. A brush rigging for dynamoelectric machines including a supporting arm adapted to hold an arcuate brush, means for pivotally mounting said supporting arm away from said brush, a relatively fixed spring stop, a relatively fixed mounting pin, and means including a substantially Z-shaped spring having a helical coiled portion at one of the joints between the fingers of the spring loosely pivotally mounted about said relatively fixed pin with the adjacent unconnected end finger biased against said relatively fixed spring stop and with the other unconnected end finger at the other end of said spring arranged in engagement with said brush supporting arm at a substantially fixed point thereon maintaining a fixed spring finger length for said other unconnected end finger for biasing said brush towards a current collector, said spring mounting pin being located relative to said spring engagement point on said brush supporting arm such that the distance between said mounting pin and said engagement point varies with pivotal movement of said supporting arm directly with the variation of spring pressure of said first-mentioned spring finger on said fixed spring stop for maintaining the pressure on the brush substantially constant.

3. A brush rigging for dynamoelectric machines including a supporting arm adapted to hold an arcuate brush, means for pivotally mounting said supporting arm at a point spaced away from said brush, the curvature of the arcuate brush being on a center corresponding substantially to the supporting arm mounting point, a relatively fixed spring stop, a relatively fixed mounting pin, and means including a substantially Z-shaped spring with the joint between two of the connected fingers of the spring coiled and loosely pivotally mounted about said relatively fixed mounting pin with the unconnected end finger thereof biased against said relatively fixed spring stop and with the unconnected third finger of said spring arranged in engagement with said brush supporting arm at a substantially fixed point thereon maintaining a fixed spring finger length for said third finger for biasing said brush towards a current collector, said fixed spring pivotal mounting pin being located relative to said spring engagement point on said brush supporting arm such

that the distance therebetween varies with pivotal movement of said supporting arm directly with the variation of spring pressure of said first-mentioned spring finger on said fixed spring stop for maintaining the pressure on the brush substantially constant.

4. A brush rigging including a supporting arm adapted to hold an arcuate brush, means for pivotally mounting an end of said supporting arm away from said brush, a relatively fixed spring stop arranged about said supporting arm pivotal mounting, and means including a spring having a pair of coiled portions arranged with the axes of said coiled portions substantially parallel and spaced apart and with one end of each of said coiled portions connected together by an uncoiled link portion, one of said coiled portions being pivotally mounted about a relatively fixed point with the unconnected end thereof formed as a finger biased against said relatively fixed spring stop and the other of said coiled portions free to move in space with the unconnected end thereof formed as a second finger arranged in engagement with said brush supporting arm at a substantially fixed point thereon maintaining a fixed spring finger length for said second finger, said spring coiled portion pivotal mounting point being located relative to said spring engagement point on said brush supporting arm such that the moment arm therebetween varies directly with the variation of spring pressure of said first-mentioned spring finger on said fixed spring stop for different positions of said brush supporting arm within a predetermined range of pivotal motion.

5. A brush rigging for dynamoelectric machines including a supporting arm adapted to hold an arcuate brush, means for pivotally mounting said supporting arm at a point spaced away from said brush, the curvature of the arcuate brush being on a center corresponding substantially to the supporting arm mounting point, a relatively fixed mounting pin, and means including a substantially Z-shaped spring with the joint between two of the connected fingers of the spring pivotally mounted about said relatively fixed mounting pin with the unconnected end finger thereof biased against said supporting arm pivotal mounting means and with the third finger of said spring arranged in engagement with said brush supporting arm at a substantially fixed point thereon maintaining a fixed spring finger length for said third finger with the ends of said spring biased toward each other for compressing said spring for biasing said brush towards a current collector, said fixed spring mounting pin being located relative to said spring engagement point on said brush supporting arm such that the distance therebetween varies with pivotal movement of said supporting arm directly with the variation of spring pressure of said first-mentioned spring finger on said supporting arm pivotal mounting means for maintaining the pressure on the brush substantially constant.

6. A brush rigging including a supporting arm adapted to hold an arcuate brush, means for pivotally mounting an end of said supporting arm away from said brush, a relatively fixed spring stop arranged about said supporting arm pivotal mounting, a relatively fixed mounting pin, and means including a substantially Z-shaped spring having a helical coiled portion at the joints between the fingers of the spring arranged with one of said helical coiled portions pivotally mounted about said relatively fixed mounting pin

with the unconnected end finger thereof biased against said relatively fixed spring stop and with the unconnected end finger of the other of said helical coiled portions arranged in engagement with said brush supporting arm at a substantially fixed point thereon maintaining a fixed spring finger length for said unconnected spring finger of the other of said helical coil portions for biasing said brush towards a current collector, said spring stop being spaced from said spring mounting pin and said spring helical coiled portion pivotal mounting pin being located relative to said spring engagement point on said brush supporting arm such that the distance between said mounting pin and said engagement point varies directly with the variation of spring pressure of said first-mentioned spring finger on said fixed spring stop for different positions of said brush supporting arm within a predetermined range of pivotal motion for maintaining the pressure on the brush substantially constant in the predetermined range of motion.

7. A brush rigging including a supporting arm adapted to hold an arcuate brush, means for pivotally mounting said supporting arm at a point spaced away from said brush, a relatively fixed spring stop, means including a spring having a pair of helical coiled portions arranged with the

axes of said helical coiled portions substantially parallel and spaced apart and with one end of each of said helical coiled portions connected together by an uncoiled link portion for biasing said brush towards a current collector, and a relatively fixed mounting pin for said spring, one of said helical coiled portions being pivotally mounted about said relatively fixed pin with the unconnected end thereof formed as a finger biased by compression of said one helical coiled portion against said relatively fixed spring stop and the other of said helical coiled portions free to move in space with the unconnected end thereof formed as a second finger arranged in engagement with said brush supporting arm at a substantially fixed point thereon maintaining a substantially fixed spring finger length for said second finger, said spring mounting pin being located relative to said spring engagement point on said brush supporting arm such that the distance therebetween varies directly with the variation of spring pressure of said first-mentioned spring finger on said fixed spring stop for different positions of said brush supporting arm within a predetermined range of pivotal motion for maintaining the pressure on the brush substantially constant in the predetermined range of motion.

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