March 3, 1964 J. GORDON 3,123,731

HYDRAULIC ACTUATED BRUSH AND HOLDER

Filed April 20, 1961 2 Sheets-Sheet 1

Fig. 1

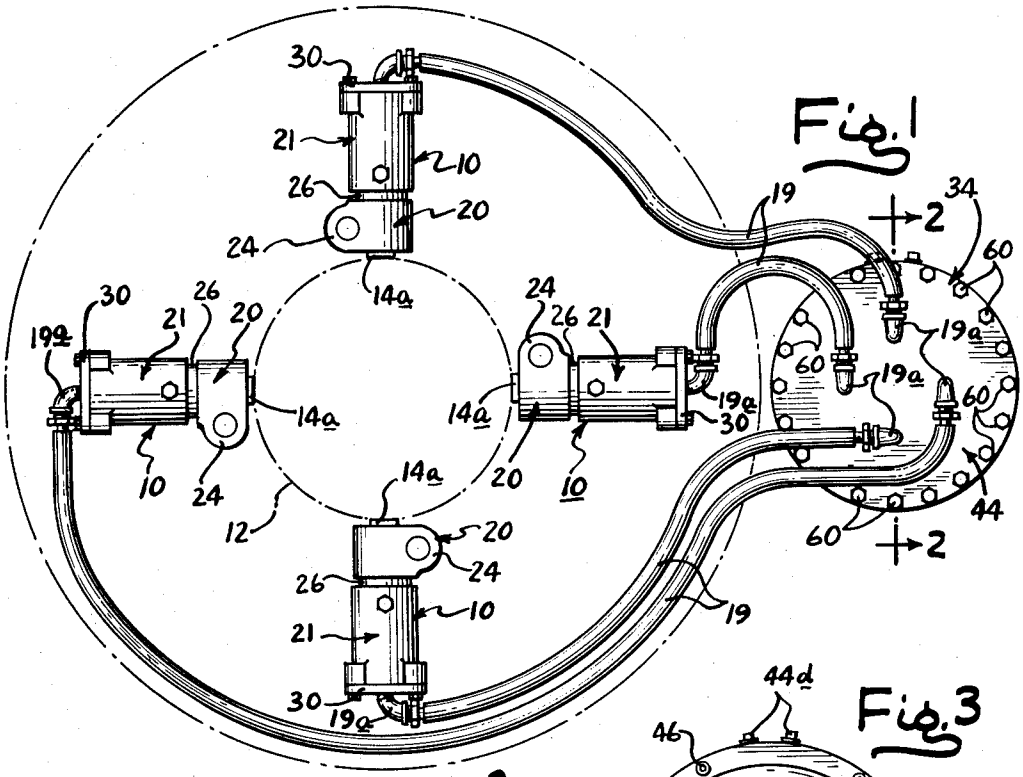


Fig. 2

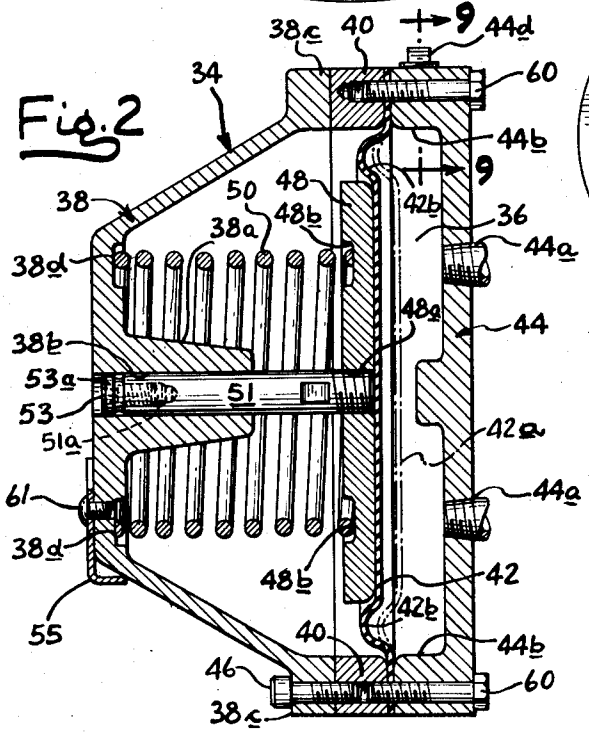
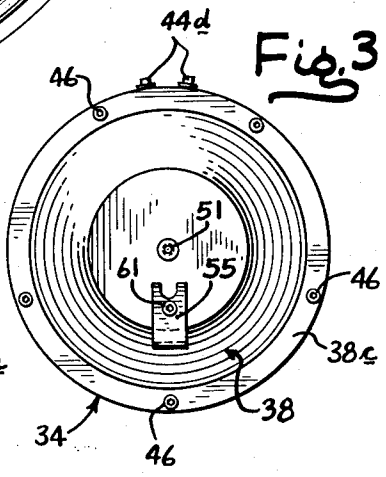


Fig. 3



INVENTOR
JAMES GORDON

by: Irwin C. Aeter ATTY.

March 3, 1964 J. GORDON 3,123,731

HYDRAULIC ACTUATED BRUSH AND HOLDER

Filed April 20, 1961 2 Sheets-Sheet 2

Fig. 8

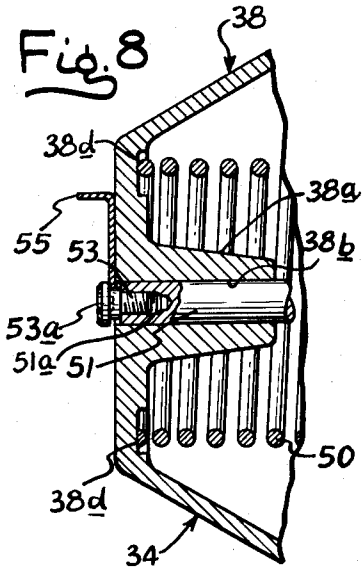


Fig. 9

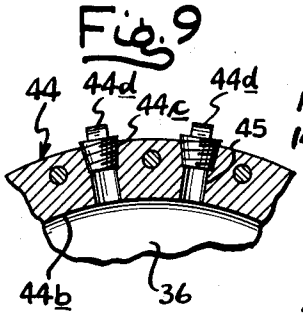


Fig. 5

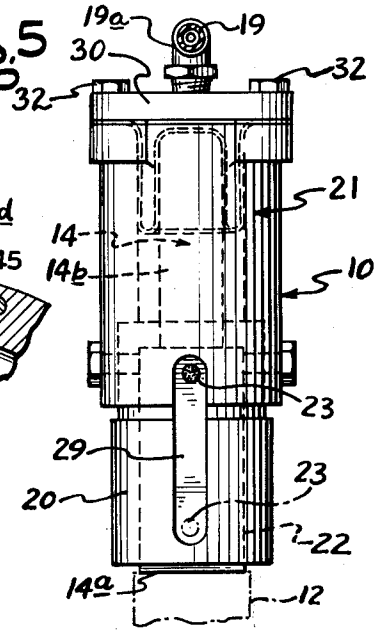


Fig. 4

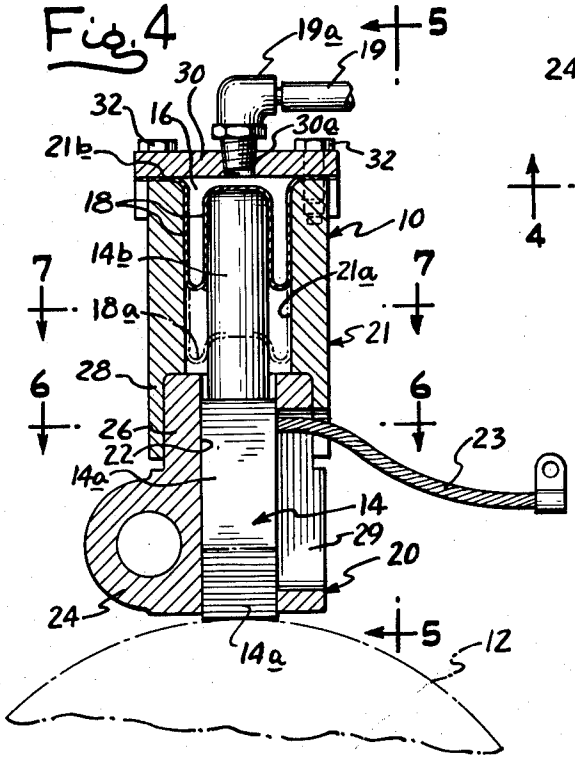


Fig. 7

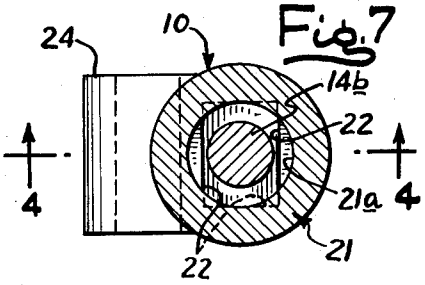
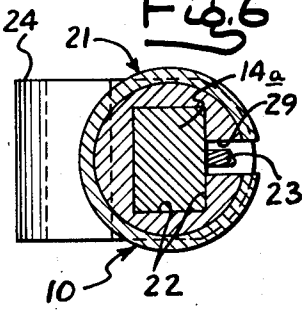


Fig. 6



INVENTOR
JAMES GORDON

by: Irwin C. Alter ATTY.

United States Patent Office

3,123,731

Patented Mar. 3, 1964

3,123,731

HYDRAULIC ACTUATED BRUSH AND HOLDER

James Gordon, 3625 N. Halsted St., Chicago, Ill.

Filed Apr. 20, 1961, Ser. No. 104,347
4 Claims. (Cl. 310—243)

This invention relates to the transmission of electrical energy to and from the commutator of a dynamo electric machine, more particularly it relates to a new and improved system for maintaining and urging the brushes of said machine in contact with said commutator.

The brushes in a dynamo electric machine form a conduit for electrical energy being transmitted to or from the commutator. It is well known that the most desirable connection between a brush and a rotating commutator is attained when there is a constant force urging the brush against the commutator. When a constant force is not applied, this results in either unnecessary wear on the brush when too much force is applied or the loss of electrical energy through electrical arcing when too little force is applied.

In the prior art, the application of urging force on the brushes is accomplished through mechanical means such, for example, as spring biasing means. Springs used in this manner have many drawbacks. A primary drawback is evident when the brushes are worn down. The springs must fully elongate themselves to urge and maintain the brushes against the commutator thereby losing their capability to exert their initial force on the brushes. When the springs cannot exert a suitable force on their brushes, they must be replaced. This, of course, means that manpower must be used and down time on the machine is increased because they must be stopped to enable replacement of the brushes. Also there is minute "bouncing" when spring pressure is used. The minute "bouncing" not only results in wear on the brush but also the heat generated from the "bouncing" causes wear and distortion on the brush holder, thereby limiting the life of both the brush holder and the brush.

To obviate these disadvantages, the prior art teaches structures where the springs can be adjusted so that they maintain their initial biasing force regardless of the position of the brushes. The disadvantage of having this type of structure is that it is not self adjusting and therefore requires attention from someone. Furthermore, because the spring must be adjusted in steps, it is very difficult to keep the spring exerting a constant pressure. Also, since this adjustable structure does not truly exert a constant and equal force, it has minute "bouncing" and all the disadvantages which are present therewith.

My invention obviates the difficulties involved with prior art systems for holding the brushes by providing fluid means such as a hydraulic system that maintains a constant and equal pressure on the brushes and advances the brushes automatically toward the commutator as the brushes are worn down.

It is therefore an object of this invention to provide a new and improved brush holder for a dynamoelectric machine which has a commutator and brush combination.

It is also an object of this invention to provide a fluid means for maintaining and urging the brushes of a dynamoelectric machine against their commutator with a constant and equal force.

Still further, it is an object of my invention to provide a hydraulic system for maintaining and urging the brushes of a dynamoelectric machine against their commutator with a constant and equal force.

Even still further, it is an object of this invention to provide automatic means for maintaining and urging the brushes of a dynamoelectric machine into contact with their commutator.

Other objects and advantages which are intended to be within the scope of this invention will be readily apparent to one skilled in the art upon reading the following specification and its appended claims wherein:

FIG. 1 is an elevational view showing the relationship of my new and improved brush holders and hydraulic system with the commutator of a dynamoelectric machine (not shown).

FIG. 2 is an enlarged half-sectional view taken on a plane through the line 2—2 and looking in the direction of the arrows in FIG. 1.

FIG. 3 is a rear view of the master cylinder illustrated in FIGS. 1 and 2.

FIG. 4 is an enlarged half-sectional view of one of my brush holders taken on a plane through line 4—4 looking in the direction of the arrows.

FIG. 5 is a side view of FIG. 4 taken on a plane through the line 5—5 looking in the direction of the arrows.

FIG. 6 is a sectional view taken on a plane through the line 6—6 looking in the direction of the arrows.

FIG. 7 is a sectional view taken on a plane through the line 7—7 looking in the direction of the arrows.

FIG. 8 is a partial portion of the sectional view illustrated in FIG. 2, said view illustrating my master cylinder's spring in its locked position.

FIG. 9 is a partial sectional view taken along the line 9—9 in FIG. 2 looking in the direction of the arrows.

Referring generally to the drawing, a plurality of brush holders are illustrated with the commutator of a dynamoelectric machine (not shown). The brush holders each have a brush therein which is urged in contact with the commutator by a diaphragm disposed in each brush holder. Each brush holder is hydraulically connected to a master cylinder to form a constant volume system whereby a constant force is exerted on each diaphragm regardless of the position of its corresponding brush. Therefore when the brushes are worn down, they are advanced toward the commutator and held in contact therewith by a constant force. As the brushes are advanced, the volume of the hydraulic system remains constant because the master cylinder readjusts the volume of the system through the use of a diaphragm.

Although my invention employs diaphragms and a particular hydraulic system to actuate the brushes, I intend that its scope shall include any brush holders having a hydraulic system that keeps the brushes in contact with the commutator. Also this invention should not only be limited to a hydraulic system but rather it is intended that its scope should include any type of fluid system, such as a gas system for example.

Referring more specifically to the drawing, four brush holders 10 are illustrated in combination with a rotating commutator 12, which is electrically connected to a dynamoelectric machine (not shown). From FIG. 1, it is seen that these brush holders 10 are hydraulically connected to a master cylinder 34 through conduits 19.

Brush Holders

As clearly illustrated in FIG. 4, each brush holder 10 has a brush 14 disposed therein and urged in contact with the commutator 12 by a hydraulic reservoir 16. Diaphragms 18 are interposed between the hydraulic reservoirs 16 and the brushes 14 whereby the hydraulic reservoirs 16 exert force on the brushes 14 by pressing the diaphragms 18 against the brushes. The diaphragm may be composed of any type of material that has such characteristics of, among others, flexibility, resistance to acids or alkalis, imperviousness to the flow of fluids and elasticity. For example, such well known materials as synthetic rubber, plastic, or impregnated cloth could be used.

The brush holders 10 of my invention basically comprise a brush positioner 20 and a brush cylinder 21. Each of the brush positioners 20 has a rectangular bore 22 therein which has the head 14*a* of its corresponding brush 14 protruding therethrough to contact the commutator 12. FIG. 4 illustrates a cross section of the brush cylinder 21 and the brush positioner 20. The brush heads 14*a* of the brush 14 are in contact with the walls of the rectangular bores 22 and have a sliding relationship therewith. Also, as can be seen from the drawing, there is a slot 29 in each brush positioner 20. The slot 29 serves the purpose of enabling a lead 23, which is attached to the brush head 14*a*, to be connected to an outside electrical source. The slot 29 also enables the brush 14 to be actuated toward the commutator 12 without losing its connection when the brush head 14*a* is worn down. The lead 23 can move along the slot 29 as the brush 14 is actuated toward the commutator 12.

The brush positioner 20 is assembled with the brush cylinder 21 in a male and female relationship. The brush positioner 20 has an outer rear cylindrical portion 26 which plugs snugly inside a cylindrical shoulder portion 28 of the brush cylinder 21. The brush cylinder 21 has a disc-shaped cover 30 fastened thereto at its rearward end 21*b* by such well known fastening means as the bolts 32. The tail 14*b* of the brush extends almost to the end of the brush cylinder 21 by protruding through the inside cylindrical hole 21*a* of the brush cylinder 21. There is no contact between the tail of the brush 14*b* and the inside hole 21*a* of the brush cylinder 21 as a space is left therebetween. This is clearly seen from FIG. 4 which shows a section of brush cylinder 21.

Diaphragms 18 are interposed between each cover 30 and the rearward ends 21*b* of the brush cylinders 21. As can be seen from the section view of a brush holder in FIG. 4, the diaphragms 18 and the covers 30 define the hydraulic reservoirs 16. The diaphragms 18 engulf the tails 14*b* of the brushes, thereby extending the hydraulic reservoirs 16 from the covers 30 to the space between the inside cylindrical holes 21*a* and the brush tails 14*b*. The dotted lines 18*a* in FIG. 4 indicate that the hydraulic reservoirs may be larger and the diaphragms accordingly stretched when the brushes 14 are worn down and have their remaining portion advanced or urged in contact with the commutator 12.

Any well known means can be used for attaching the brush holders 10 to the dynamoelectric machine. In my specific embodiment, the rings 24 of the brush positioners 20 are used to attach the brush holders 10 to the guide posts of a dynamoelectric machine (not shown).

Master Cylinder

The master cylinder 34, a section of which is clearly illustrated in FIG. 2, is provided for maintaining a constant pressure in the brush holders' hydraulic reservoirs 16 whereby a constant force is exerted on the diaphragms 18 regardless of the stretch of the diaphragms or the positions of the brushes 14. The master cylinder 34 has a hydraulic reservoir 36 which is connected to each of the brush holder cylinders 21 through outlets 44*a* in the master cylinder base 44.

The conduits 19 are attached to the elbows 19*a* at the outlets 44*a* and each conduit leads to and is attached to a brush holder through the elbows 19*a* which are attached to the outlets 30*a* in the brush cylinder covers 30.

The master cylinder 34 has a rear cover 38 with a hub 38*a* at its middle that has a bore 38*b* therethrough. The master cylinder cover 38 has an inside groove 38*d* therein to receive and position a compression spring 50. The cover 38 has a front end boss 38*c* which fits with and is adjacent to ring 40. A diaphragm 42 has its periphery interposed between ring 40 and the boss 44*b* of the master cylinder base 44 and it has the bolts 60 protruding therethrough to form a subassembly of the master cylinder 34. As shown in FIG. 2, the diaphragm can be molded so

that it has a circular arcuate groove 42*b* in order that when the diaphragm is advanced to the position shown by the dotted lines 42*a*, a smaller bending moment is exerted on points immediately adjacent to where the diaphragm is attached. As seen in FIG. 2, the subassembly of the base 44 with the diaphragm 42 and ring 40 is attached to the master cylinder cover 38 by a plurality of bolts 46 protruding through the boss 38*c* and the ring 40.

A disc-shaped loader plate 48 which is adjacent to the diaphragm has a groove 48*b* therein to receive and position the ends of the compression spring 50 which are disposed between the loader plate 48 and the rear cover 38. The loader plate 48 has a threaded hole therein which is attached to the threaded end of a guide stud 51, the guide stud protruding through the rear cover bore 38*b*. The guide stud 51 has a tapped hole 51*a* at one of its ends and it has a large headed screw 53 attached thereto. As seen in FIG. 8, the screw head 53*a* of the screw 53 is locked with a key 55 so that the spring 50 is kept compressed until the master cylinder 24 has fluid in it, as will be explained more fully hereinafter.

Assembling the Master Cylinder for Operation

To assemble and put the master cylinder 34 into operation, the diaphragm 42 has its peripheral edge interposed and clamped between ring 40 and the master cylinder base 44 by such means as the bolts 60 to form a subassembly. The loader plate 48 and spring 50 are positioned inside of the cover 38 and the guide stud 51 is inserted through the bore 38*b* of the master cylinder cover 38 and is screwed into the threaded hole 48*a* of the loader plate 48 to form the cover assembly. It should be noticed that the key 55 keeps the spring 50 compressed by locking the screw head 53*a*, which in turn restrains the loader plate 48, as illustrated in FIG. 8. The cover assembly is then bolted to the subassembly consisting of the ring 40, diaphragm 42 and the base 44. The outlets 44*a* are connected to their respective outlets 30*a* and the master cylinder 34 is then filled with hydraulic fluid through the tap filling hole 44*c* in the base 44. The tap filling hole 44*c* is closed with plug 44*d* and the compression spring 50 is then released by removing the key 55 to unlock the screw head 53*a*. The key 55 may then be assembled to the master cylinder cover 38 by a bolt 61 as shown in FIGS. 2 and 3. From FIG. 9 it is seen that the base 44 has another hole 45 besides the hole 44*c*. The hole 45 is used for the purpose of venting the hydraulic system.

Summary of Operation of System

The operation of my new and improved system for maintaining and urging the brushes into contact with the commutator 12 is briefly as follows:

The diaphragms 18 in the brush holders 10 exert a constant force on the brushes 14 because the compression spring 50 is exerting a constant force onto the master cylinder diaphragm 42. When the tails of the brushes are advanced, such as for example to the dotted lines 18*a* shown in FIG. 4, the hydraulic system maintains a constant volume because the compression spring 50 advances the diaphragm 42 a sufficient distance to decrease the volume of its hydraulic reservoir 36 the same amount as the brush holder hydraulic reservoirs are increased by the stretching of the diaphragms 18. Since the volume remains constant and a constant force is exerted on the hydraulic system, a constant force urges the brushes 14 into contact with the commutator 12.

Even though I use a spring in my master cylinder to exert pressure on the hydraulic fluid, this spring does not introduce the inherent disadvantages that were present in the prior art brush holders which were operated directly by springs. This is because in the prior art structures, the springs were elongated by magnitudes of an inch or more. On the other hand, my spring is extended no more than a fraction of an inch, as seen by the dotted

lines 42*a* in FIG. 2. It is well known that the life of a spring is predicated on the number of times it is forced to approach its elastic limit. In my structure, the movement is so small in relation to the capacity of the springs that the springs should last indefinitely.

Therefore it can be said that my invention eliminates the disadvantages of prior art devices by providing a fluid means for automatically urging and maintaining a brush in contact with its commutator with a constant pressure. It further provides a brush holder which can be infinitely adjusted to exert a desired or optimum pressure on its respective brush. Also my invention provides a brush holder which has few parts and is so simple in construction that its brushes may be replaced very easily and quickly.

It is to be understood that the specific embodiment of the invention shown in the drawings and described in detail above is merely illustrative of one of the many forms which the invention may take in practice and that numerous variations and modifications thereof may be made without departing from the scope of the invention as delineated in the appended claims which are to be construed as broadly as permitted by the prior art.

I claim:

1. In combination a rotating commutator electrically attached to a dynamoelectric machine, a plurality of brushes in electrical contact with said commuator, a plurality of brush holders to hold and urge each of said brushes in electrical contact with said commutator, said brush holders each having a hydraulic reservoir, diaphragms interposed between said reservoirs and said brushes whereby said hydraulic reservoirs exert pressure on said brushes by pressing said diaphragms against said brushes, said diaphragms stretching when said brushes are worn down whereby the volume of said brush reservoirs is increased and said brushes are urged and kept in contact with said commutator, and means for maintaining said hydraulic reservoirs at a constant pressure whereby a constant force is exerted on said diaphragms regardless of their stretch or the position of said brushes, said means comprising a master cylinder having a hydraulic reservoir which is connected to each of said brush holder reservoirs to form a constant volume system, said master cylinder's hydraulic reservoir having a spring biased diaphragm exerting a constant force on it, said master cylinder's diaphragm stretching when said brush holder diaphragms are stretched, whereby a constant volume is maintained in said hydraulic system and accordingly a constant force is exerted on said brushes at all times.

2. In combination: a brush holder for a dynamoelectric machine having a means responsive to a hydraulic reservoir for urging a brush into electrical contact with the commutator of a dynamoelectric machine, and a master cylinder connected to said hydraulic reservoir, said master cylinder having a subassembly including a ring and a base with a diaphragm held therebetween at its periphery, said diaphragm forming a hydraulic reservoir with said base, said diaphragm having a circular arcuate groove extending to points immediately adjacent to where said diaphragm is held, said diaphragm being biased by a compression spring whereby a constant force is exerted on said master cylinder reservoir.

3. In combination: a brush holder for a dynamoelectric machine having means for urging a brush into electrical contact with the machine's commutator, said means being responsive to a hydraulic reservoir, and a master cylinder connected to said hydraulic reservoir, said master cylinder having a ring and a base with a diaphragm held therebetween at its periphery to form a subassembly, said diaphragm forming a master cylinder hydraulic reservoir with said base, said diaphragm having a circular arcuate groove near to points immediately adjacent to where said diaphragm is held, a cover assembly attached to said subassembly, said cover assembly being a cover assembled with a diaphragm loader plate by a guide stud protruding through said cover, a compression spring interposed between said loader plate and said cover, said guide stud having means for keeping said compression spring compressed until it is desired to release said spring to exert force on said diaphragm.

4. Master cylinder means for applying a constant pressure to a plurality of hydraulic reservoirs having diaphragms intermediately disposed in relation to brush elements to urge said brush elements into contact with the commutator of a dynamoelectric machine comprising: a main hydraulic reservoir in communication with each of said brush elements' reservoir, a diaphragm held in position by said master cylinder, and spring biasing means urging said master cylinder's diaphragm against said main hydraulic reservoir, whereby said master cylinder's diaphragm is stretched in relation to that of said brush elements' diaphragms to maintain a constant volume and pressure in the system.

References Cited in the file of this patent

UNITED STATES PATENTS

497,361	Thomson	May 16, 1893
821,197	Speirs	Aug. 29, 1905
884,049	Speirs	Apr. 9, 1908
1,448,377	Bethel	Mar. 13, 1923
1,896,164	Chandejsson	Feb. 7, 1933

FOREIGN PATENTS

10,220	Great Britain	of 1906
629,788	Great Britain	Sept. 28, 1949
1,089,470	Germany	Sept. 22, 1960