United States Patent

Kirwan et al.

[15] **3,639,941**

[45] **Feb. 8, 1972**

[54] VACUUM CLEANER

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[22] Filed: **June 16, 1970**

[21] Appl. No.: **46,615**

[52] **U.S. Cl.** **15/372**, 15/389

[51] **Int. Cl.** **A47l 5/34**

[58] **Field of Search** 15/355, 356, 357, 358, 359, 15/360, 368, 371, 372, 389

[56] **References Cited**

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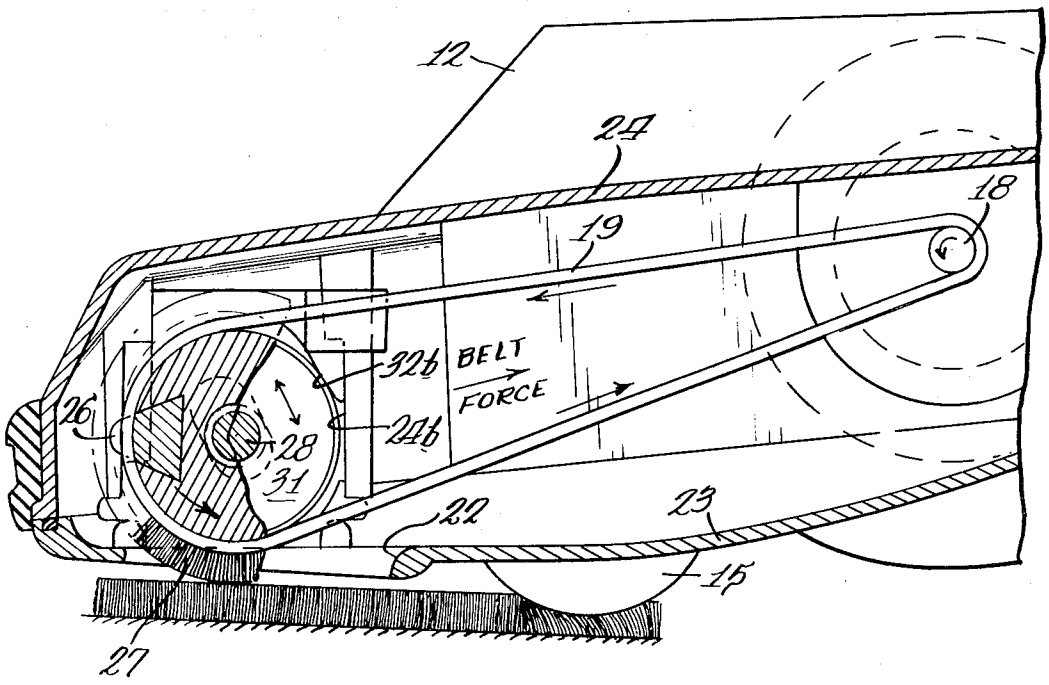
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[57] **ABSTRACT**

A rotary brush for a vacuum cleaner including mounting means for biasing the brush downwardly against the rug through the use of the tension applied by the belt drive from the motor.

8 Claims, 8 Drawing Figures



PATENTED FEB 8 1972

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SHEET 1 OF 3

Fig. 1.

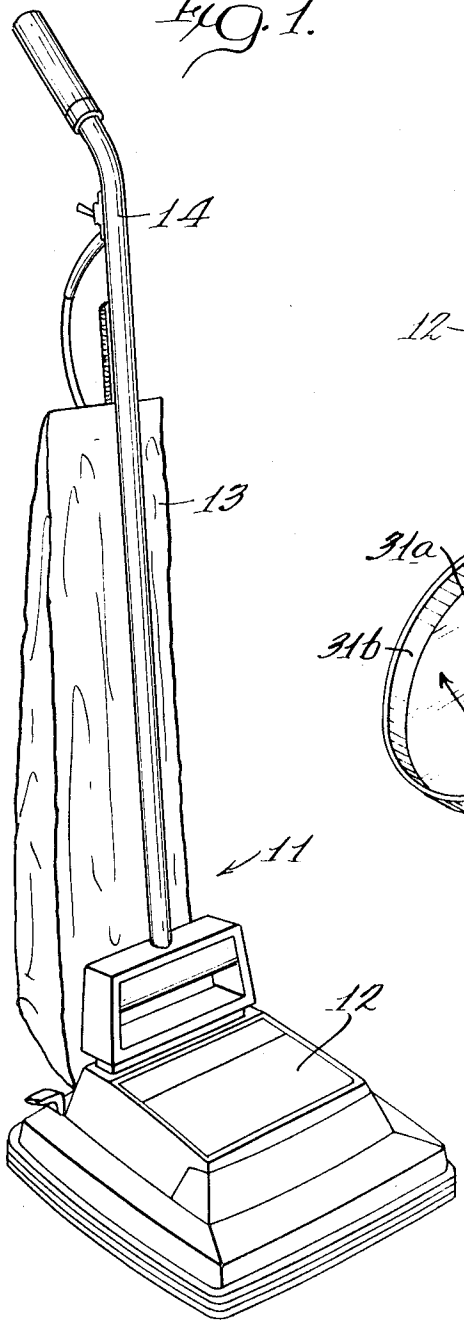
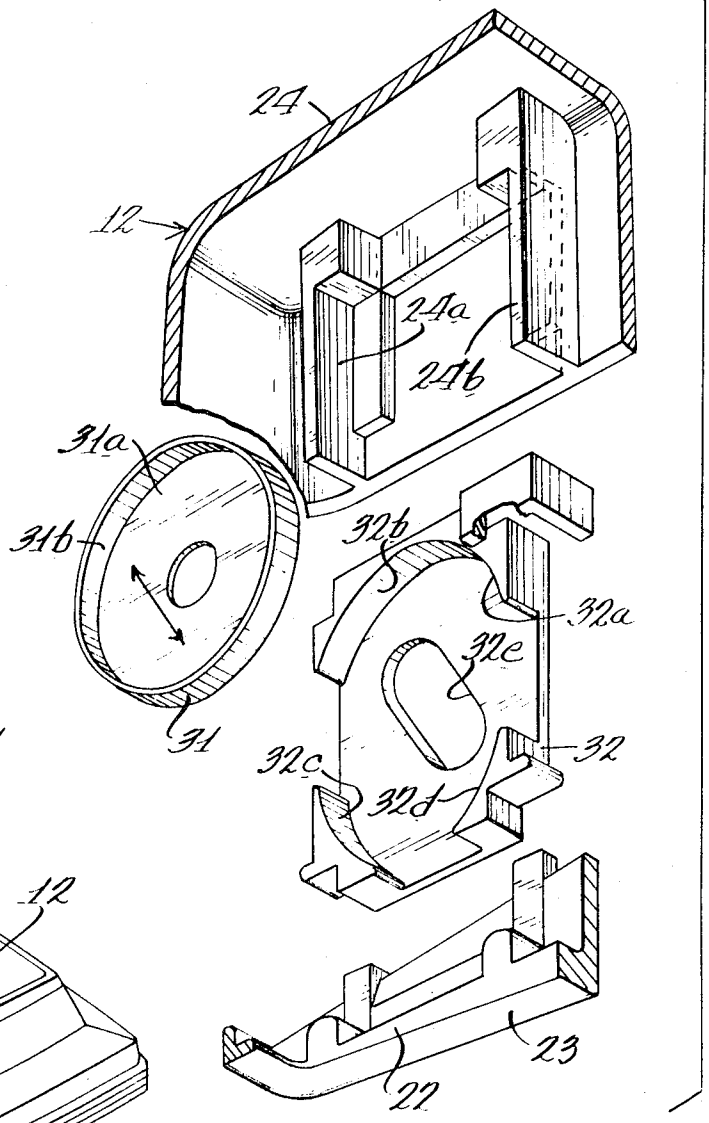


Fig. 4.



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Fig. 2.

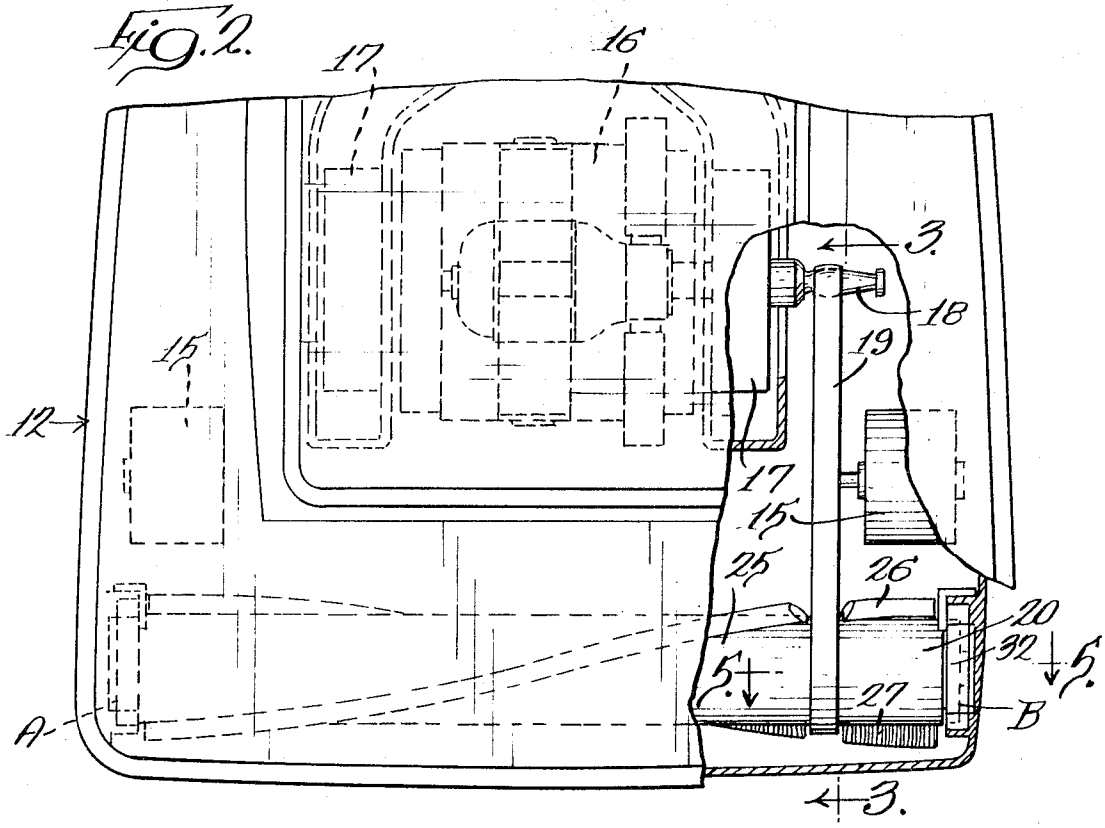
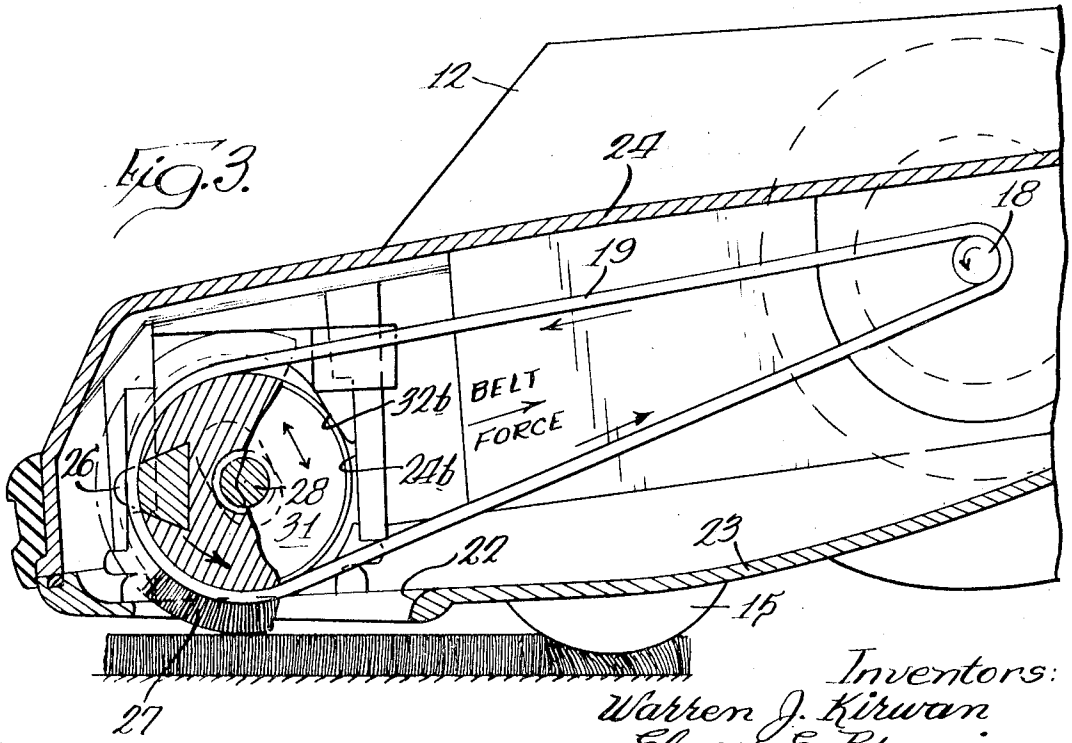


Fig. 3.



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Fig. 5.

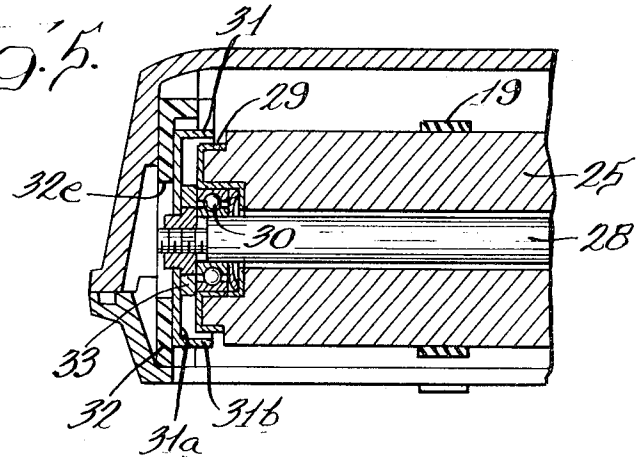


Fig. 6.

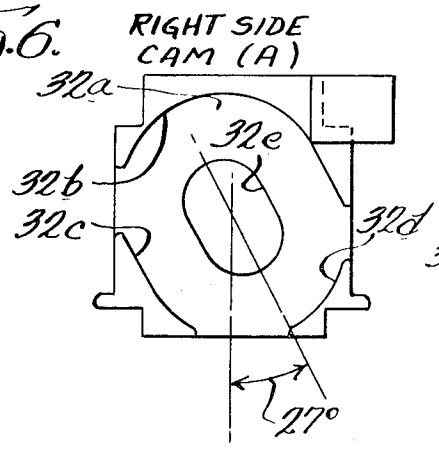


Fig. 7.

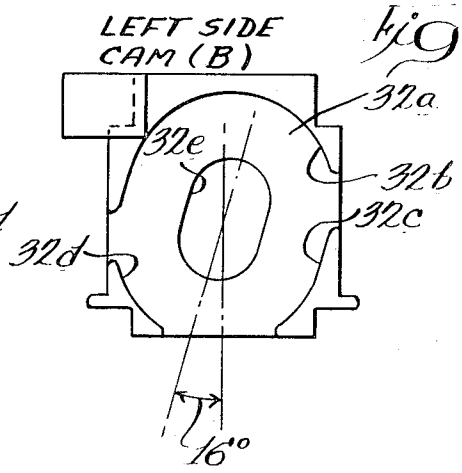
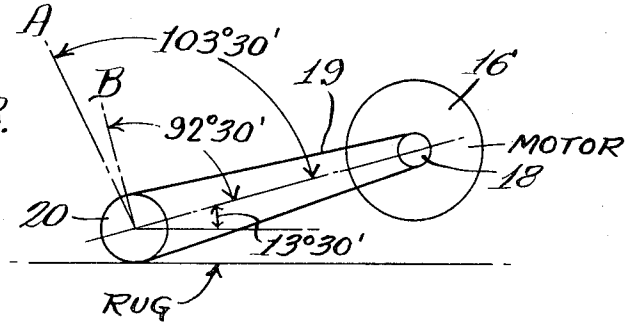


Fig. 8.



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VACUUM CLEANER

BACKGROUND OF THE INVENTION

Upright vacuum cleaners are conventionally provided with a motor which rotates a fan to create a vacuum and are also provided with a rotating brush which engages the carpet to dislodge dirt and dust so that it may be picked up in the airstream and carried into the dirt-receiving receptacle on the vacuum cleaner. Such brushes are driven by the same motor as the vacuum producing fan and are located in the forward portion of the housing in the nozzle portion or nozzle opening.

The rotary brush is positioned to extend downwardly past the face of the nozzle opening a short distance so that, as the nozzle-defining portion of the housing engages the carpet, the brush will extend into the carpet slightly and accomplish the beating and brushing to dislodge the dirt. While this relationship between the outer periphery of the brush and the face of the nozzle may be optimized for one particular type of carpet, there are many factors such as the type of carpet, the depth of the nap, and the stiffness which may affect the optimum position of the brush with respect to the nozzle. In fact, some of the very high pile or shag carpets which are very popular today extend substantially into the nozzle and tend to interfere to an undesirable extent with the rotary brush. In some instances, the interference is so great as to stall out the brush causing the belt drive to break or burn out the motor.

There have been attempts in the past to provide a movable or floating mounting for the rotary brush to avoid situations in which the brush is stalled. In such a floating mounting, the brush is biased downwardly with respect to the nozzle or housing, and in the case of engagement with a deep pile or heavy carpet, the brush is forced upwardly in opposition to the biasing means. In general, such attempts have been costly and unsatisfactory from a mechanical standpoint because of the complicated mechanisms necessary to accomplish the floating mounting. A vacuum cleaner presents substantial problems from a service standpoint if any mechanism subjected to the dirt from the floor is in the least bit complicated and not well shielded or protected from the dirt. The dirt and dust tends to deposit in the mechanism and cause it to malfunction rather quickly. Accordingly, it would be desirable to provide a mechanically simple, rotary brush biasing means for an upright vacuum cleaner.

SUMMARY OF THE INVENTION

The invention involves mounting the rotating brush of an upright vacuum cleaner in a manner so that it may move vertically in response to overloading or pressure created by the carpet pile. The brush is biased to its lowermost portion by means of the resilient belt which drivingly interconnects the brush and the motor. Cam means are provided so that the belt tension increases as the brush moves upwardly thereby tending to urge the brush to its lowermost position.

Since almost all upright vacuum cleaners have a belt to drive the rotary brush and have this belt in a position offset from the centerline of the vacuum cleaner, it is necessary to provide means for equalizing the biasing force exerted by the belt on the floating rotary brush. This equalization is accomplished by providing different cams at either end of the brush which cams compensate for the fact that the belt is positioned closer to one of the cams than the other. More specifically, the angled cam slots engaging the brush bearing cam followers are such that the slot positioned closest to the belt drive is positioned almost perpendicular to the belt direction while the cam slot located more remote from the belt drive is at more of an angle to the belt direction.

It is an object of the present invention to provide an improved upright vacuum cleaner having a floating rotary brush which is driven by the vacuum motor.

It is a further object of the present invention to provide an upright vacuum cleaner having a floating rotary brush which is biased downwardly into engagement with the carpet by means of the tension in the resilient belt which drivingly connects the brush with the motor.

Another object of the present invention is to provide an improved floating brush for a vacuum cleaner wherein the brush is biased downwardly by means of belt tension and the biasing force is equalizing on the opposite ends of the brush by providing cam surfaces having differing slopes to compensate for the displacement of the belt drive with respect to the centerline of the vacuum cleaner.

Further objects and advantages of the present invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, reference may be had to the accompanying drawings in which:

FIG. 1 is a perspective view of an upright vacuum cleaner embodying our invention;

FIG. 2 is an enlarged fragmentary plan view of a portion of the vacuum cleaner housing with a section cut away to dispose the belt drive between the motor and the rotary brush;

FIG. 3 is an enlarged sectional view taken substantially on line 3—3 of FIG. 2;

FIG. 4 is an exploded perspective view of the brush supporting mechanism at one edge of the vacuum cleaner;

FIG. 5 is an enlarged fragmentary sectional view taken on line 5—5 of FIG. 2 assuming FIG. 2 shows the complete cleaner;

FIG. 6 is an elevational view of the right brush cam;

FIG. 7 is an elevational view of the left brush cam; and

FIG. 8 is a schematic diagram showing the angular relationship between the right and left brush cams and the center line of the drive pulley or belt.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is shown in FIG. 1 a vacuum cleaner designated by reference numeral 11. The vacuum cleaner 11 is generally conventional including a housing portion 12, a dust-receiving bag 13, and an upwardly extending handle 14 which is pivotally supported at its lower end to the housing 12. In normal operation, the handle 14 is grasped at its upper end by the user and pivoted to a convenient angled position to propel the housing 12 across the carpet to be cleaned.

For the purpose of supporting the vacuum cleaner 11 for movement across the surface to be cleaned, there are provided wheels or rollers which are located generally in the four corners of the underside of the housing 12. Also enclosed within the housing 12 is a motor 16 which is provided with one or more fans 17. The motor 16 and the fans 17 operate in a well-known manner to create a flow of air through the housing 12 into bag 13 which is provided with a suitable disposable paper dust bag to receive the dirt and debris.

The motor 16 is formed with an output shaft 18 which is coupled by means of a resilient belt 19 to a rotary brush 20. The brush 20 is positioned in the forward part of the housing 12 with its lower edge extending through nozzle opening 22 formed in the lower housing member 23. The housing 12 is partially defined by an upper housing member 24 which supports the motor and the rotary brush 20. The brush 20 is of conventional design including a cylindrical hub 25 on which is helically disposed a carpet beating bar 26. The bar 26 is designed to pound the rug nap and dislodge dust and dirt. A helical brush portion 27 protrudes substantially the same distance from the hub 25 as the bar 26. The brush portion 27 provides a different type of cleaning action as compared to the bar 26 and supplements the action of the bar 26.

The brush 20 is further provided with an axle 28 which extends outwardly and into engagement with the supporting mechanism provided on the interior of the housing 12. The

axle **28** supports the wooden brush hub **25** for relative movement by means of ball bearings **30**. The outer race of each of the bearings **30** is fixed with respect to the hub **25** by means of a cap **29**, whereas the inner race is secured to the axle **28** as is best shown in FIG. **5**.

In order to permit the axle **28** and the associated brush **20** to move vertically in response to loads applied against the brush, there is provided at each end of axle **28** a circular cam follower **31** which is received in a cam means **32** as shown in FIG. **4**. There is a cam means **32** on each side of the housing **12** and each includes an elongated recess **32***a* within which the cam follower **31** is received. The recess **32***a* is defined by upper cylindrical wall **32***b* and two lower walls **32***c* and **32***d*. These walls together with the adjacent walls **24***a* and **24***b* on the upper housing member **24** form an elongated oval or elliptical recess which is similar in shape to a clearance opening **32***e* formed in the center of the cam means **32**. The cam means **32** is retained in position between the walls **24***a* and **24***b* by the nozzle plate **23** which abuts against the lower edge of the cam means **32**.

When the brush **20** and its associated axle **28** and the cam follower **31** are assembled to the housing **12**, the cam follower **31** is received within the recess **32***a* and is guided for generally vertical movement by means of the walls of the recess **32***a*. The cam follower **31** is threadedly secured to the outer end of the axle **28** whereby the entire brush **20** moves upwardly when the cam follower **31** moves upwardly within the recess **32***a*. The clearance slot **32***e* merely permits the end of the axle **28** to extend therethrough.

Considering FIG. **2** of the drawings, it will be noted that the belt **19** is connected to the brush **20** at a point close to one of the ends of the brush, the end at which the housing is cut away is shown in FIG. **2**. For the purposes of explanation, the brush support structure at the right side of the cleaner, as viewed by the operator standing behind the cleaner, has been designated by the letter A whereas the support structure at the left side has been designated by the letter B. In order to equalize the downward biasing force applied at each of the cam means, it is necessary to angle the recesses **32***a* a different amount to compensate for the fact that the belt **19** applies a greater force at left side (B) than it does at the right side (A). Accordingly, as shown in FIGS. **6**, **7**, and **8**, the recess **32***a* at side B extends at an angle of approximately 16° to the vertical whereas the recess **32***a* in side A extends at an angle of approximately 27° to the vertical. With this arrangement, the resilient belt **19** applies a biasing force at the cam means at A and B which is substantially equal in spite of the fact that the belt is located substantially closer to left side (B). As indicated in FIG. **8**, at side B, the belt **19** applies its force to follower **31** and recess **32***a* almost perpendicular to the direction of the recess, i.e., at an angle of 92° 30′. A the other side A more remote from the belt **19** the angle is 103° 30′.

In considering the operation of the device, reference should be made to FIG. **3** wherein the brush **20** is shown in position disposed slightly upwardly from its lowermost position. As may be seen in FIG. **3**, the cam follower has moved up within the recess **32***a* as a consequence of a load or force being applied by the rug against the lower portion of the brush. As the cam follower **31** moves upwardly, the wall **32***b* is angled so that the hub **25** of the brush **20** moves away from the armature shaft **18** thereby placing an increased tension on the belt **19**. The belt **19**, therefore, tends to urge the brush **20** downwardly to its lowermost position.

With increasing loads on the bottom edge of the brush **20**, the cam follower **21** may be made to move upwardly until the brush **20** is entirely within housing **12** and no longer protrudes through the nozzle opening **24**.

The cam follower is of sufficient diameter to operate with low frictional losses and is arranged to protect the bearings **30**. It should be noted that the cam follower **31** has a recessed pocket **31***a* within which the end of the hub **25** extends. An outer flange or wall **31***b* of the follower **31** tends to provide a baffle which prevents dust and dirt from depositing within the ball bearings **30**. There is also provided a seal **33** which prevents dust from entering the bearing **30**. Because of the size of the recess **32***a* and the cam follower **31**, there is little tendency for dirt and dust to interfere with the operation of the cam means **32**.

Accordingly, it should be understood that the floating brush structure is obtained by simply modifying the design of parts which are used in most upright vacuum cleaners. The cam follower **31** and a part similar to the cam means **32** are common parts in the conventional vacuum cleaner as means to mount the ends of the axle **28**. The modification of these two parts is of no significance from a cost standpoint since they are inexpensive molded and stamped parts. At the same time the cam follower **31** serves to protect the brush bearings from dust and dirt, because of its size, it is a highly effective cam arrangement which is not likely to malfunction. The biasing means for the floating brush consists merely of the belt **19** which is conventional in almost all upright vacuum cleaners and represents no addition in cost or structure. By utilizing the cam means **32** having different angles with respect to the vertical, the brush biasing force is equalized in spite of the fact that the belt **19** is displaced from the center of the brush.

While there has been shown and described a particular embodiment of the present invention, it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the invention in its broader aspects, and it is, therefore contemplated in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the present invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In an upright vacuum cleaner of the type having a motor-driven cylindrical brush positioned for engagement with the carpet, the improvement comprising a frame mounting an electric motor, said motor having a horizontally disposed output shaft, a rotary brush supported on said frame in parallel spaced relation to said output shaft, a resilient belt drive connecting said shaft in driving relation to said brush, spaced bearings journaling said brush, said bearings being supported for vertical movement relative to said frame, movement of said bearings upwardly causing an increase in tension in said belt whereby said belt biases said brush to its lowermost position with respect to said frame, cam means in said frame for supporting said brush, said cam means including two cam surfaces angled with respect to a plane perpendicular to said belt, said cam surfaces being at opposite ends of said brush, a cam follower supported at each end of said brush to engage one of said cam surfaces, said brush being movable upwardly with said cam means and cam follower increasing the tension in said belt.

2. The combination of claim **1** wherein said belt drive is closer to one of said cam surfaces than to the other, the cam surface nearest to said belt being angled less with respect to said perpendicular plane to provide an equal camming force at each end of said brush.

3. The combination of claim **1** wherein said brush includes a hub having an elongated axle extending lengthwise therethrough, bearings at each end of said hub journaling said hub with respect to said axle, said cam follower supporting said bearings with respect to said frame.

4. The combination of claim **3** wherein said cam means comprise oval recesses at each end of said brush, said recesses extending at an angle to a plane perpendicular to the center line of said belt, and said cam followers at each end of said axle being received in said recesses.

5. The combination of claim **4** wherein said belt is positioned closer to one cam means than the other, the cam means positioned closest to said belt having its recess extending at less of an angle to said perpendicular than the other than the other recess.

6. An upright vacuum cleaner comprising a housing enclosing a motor drivingly connected to a fan and to a rotary brush, said brush being positioned in the air stream produced by said

fan and mounted in a nozzle opening in said housing for engagement with a surface to be cleaned, means mounting said rotary brush for vertical movement with respect to said housing wherein said brush may extend from said nozzle varying amounts, a resilient belt drivingly connecting said motor and said brush, and cam means between said brush and said housing for increasing said belt tension as said brush moves upwardly, said belt biasing said brush to its most downwardly extended position with respect to said nozzle and housing, said cam means including spaced cams on opposite walls of said housing and cam followers slidably engaging said cams and received on the opposite ends of said brush, said cams urging said brush away from said motor and tensioning said belt as said brush is biased upwardly with respect to said housing.

7. The vacuum cleaner of claim 6 wherein said cam followers comprise cup-shaped members received on the ends of a brush supporting axle, brush bearings between said axle and said brush shielded by said cam followers, said cam followers being received in said cams.

8. An upright vacuum cleaner comprising a housing enclosing a motor drivingly connected to a fan and to a rotary brush, said brush being positioned in the airstream produced by said fan and mounted in a nozzle opening in said housing for engagement with a surface to be cleaned, means mounting said rotary brush for vertical movement with respect to said housing wherein said brush may extend from said nozzle varying amounts, a resilient belt drivingly connecting said motor and said brush, and cam means between said brush and said housing for increasing said belt tension as said brush moves upwardly, said belt biasing said brush to its most downwardly extended position with respect to said nozzle and housing, said housing comprises an upper housing member which supports said motor and brush and a lower housing member which forms the bottom wall of said housing, said nozzle opening being formed in said lower housing member, said cam means being clamped in position at the ends of said brush by said upper and lower housing members.

* * * * *