Sept. 23, 1952 B. B. SCOTT 2,611,847

CAM-ACTUATED DEVICE

Filed Dec. 14, 1950

FIG. 2

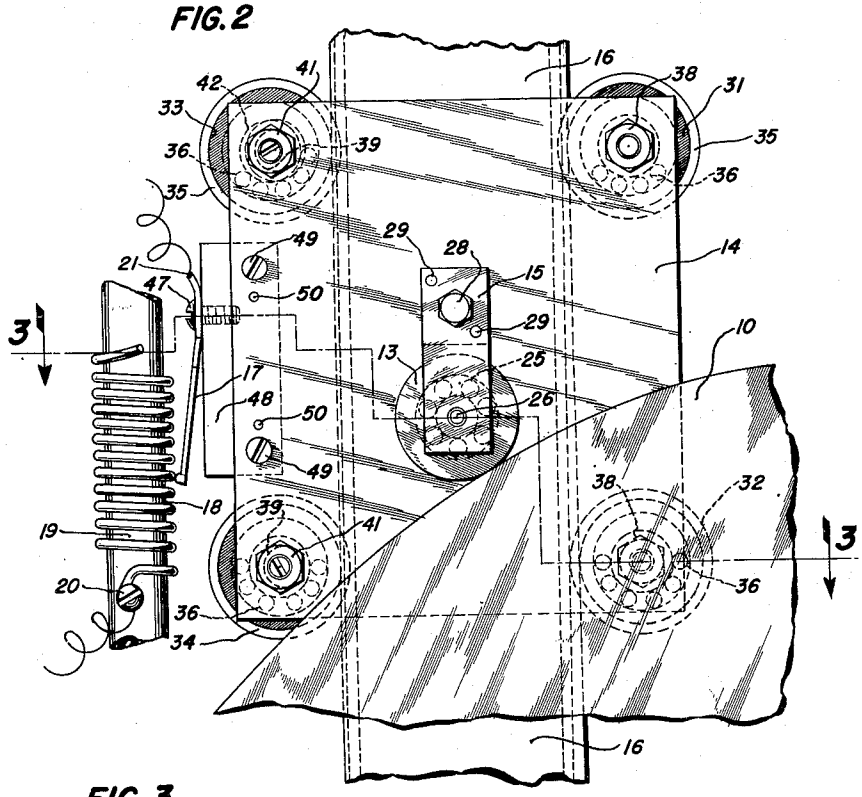


FIG. 3

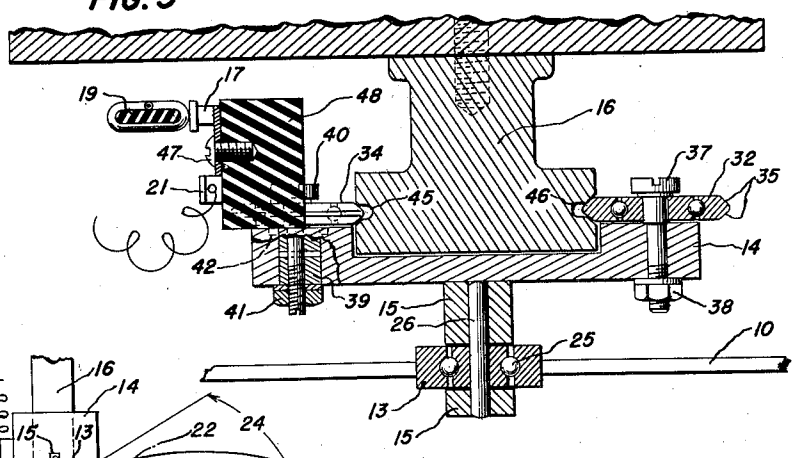
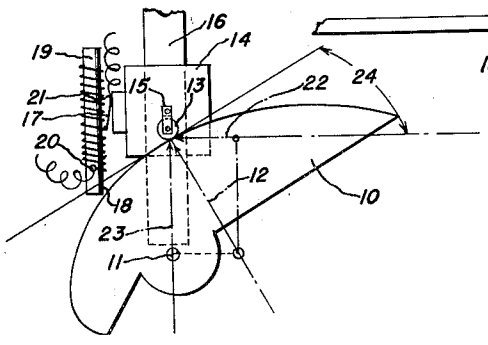


FIG. 1



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CAM-ACTUATED DEVICE

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4 Claims. (Cl. 201—48)

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The invention relates to improvements in cam-actuated devices such as electrical brushes for variable resistors.

An important object of the invention is to provide a cam-actuated electrical brush support so constructed and arranged as to minimize its frictional resistance to cam-actuated movement whereby the use of a cam having the theoretically maximum usable slope of cam approach angle is made practicable.

Another object is the provision of a cam-actuated electrical brush carriage movable along a guide rail on antifriction rollers adapted to grip opposite sides of the guide rail with a minimum of lost motion.

Other objects and advantages of the invention will become apparent during the course of the following detail description taken in connection with the accompanying drawing forming a part of this specification and in which drawing:

Fig. 1 is a side elevational view of a cam-actuated brush carriage and vectors diagrammatically illustrating the cam forces;

Fig. 2 is an enlarged fragmentary view in side elevation of the assembly shown in Fig. 1; and

Fig. 3 is a horizontal sectional view substantially on the line 3—3 of Fig. 2.

In the drawing, which for the purpose of illustration shows only a preferred embodiment of the invention, and wherein similar reference characters denote corresponding parts throughout the several views, the numeral 10 in Fig. 1 designates a plate cam rotatable about an axis 11 to exert a force 12 against an antifriction roller-type follower 13 attached to a brush carriage 14 as by a bifurcated bracket 15. This brush carriage 14 rolls along a vertical rail 16 so aligned that its longitudinal axis extends normal to the cam axis 11 whereby the entire path of travel of the follower 13 is radial to the cam axis 11. Insulatively attached to the carriage 14 is a brush 17 adapted to slide along the edge 18 of a wire-wound linear master card 19 upon movement of the carriage. Inasmuch as carriage movement is produced by rotation of the cam 10, the electrical output from the linear master card, derived through terminal and brush connections, 20, 21, is in accordance with the law or formula with which the design of the cam conforms. It will be observed in Fig. 1 that the force 12 normal to the tangent defined by the point of contact of the cam and follower can be separated into components one 22 perpendicular to the rail 16 and another 23 longitudinally of the rail. The perpendicular component 22 produces double-wedge friction effects at the point of cam contact with the follower and at the points of bearing between the carriage and rail and, assuming that there are no gravity effects on the carriage, these friction forces determine the magnitude of the longitudinal component force 23 required to move the carriage along the rail. The magnitude of these forces is determined largely by the slope of the tangent defining the cam approach angle 24 relative to the longitudinal axis of the carriage 14, these forces increasing as a preponderantly sine function of the angle 24. Accordingly, comparatively enormous friction obtains with large magnitudes of the approach angle 24. In general, gravity forces acting lengthwise of the carriage and rail are not negligible since in practice it has been found desirable to use a gravity weight to insure close contact between the cam 10 and its follower 13. Even when the gravity pull of a carriage weight or of the carriage itself is small, it can be seen that large values of angle 24 require increasingly larger camming forces to overcome both gravity and frictional resistance to movement of the carriage along the rail. If the follower 13 were of the rounded chisel point type, friction bind would occur at a value of approximately 20° for angle 24, whereas friction bind of the antifriction roller-type follower 13 occurs when the angle 24 is around 45°.

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Referring now more particularly to Figs. 2 and 3, it is clear that the cam follower roller 13 turns on antifriction bearings 25 about a shaft 26 in the yoke-shaped bracket 15. This bracket 15 is centrally fastened to the carriage 14 as by a cap screw 28 and dowel pins 29. The rectangular carriage 14 is equipped at its corners with four antifriction rollers 31–34 having beveled peripheries 35 of V-shape in cross section. Two of the rollers 31, 32 are mounted on antifriction bearings 36 for rotation about fixedly located axes as by headed screws 37 and nuts 38. The other two rollers 33, 34 are mounted on similar antifriction bearings 36 for rotation about adjustably located axes as by eccentrics 39 fast on mounting screws 40 slotted to receive a screwdriver. Following screwdriver adjustment of roller clearance with the rail 16, nuts 41 on the mounting screws 40 are tightened to releasably fix the position of the rollers 33, 34 on the carriage. If the eccentrics are flanged at 42, the rollers 33, 34 will not bind when the nuts 41 are tightened.

The V-rollers 31–34 are formed of glass-hard steel beveled by precision grinding to included

angles of approximately 44°. The rail **16** is a glass-hard precision-ground rectangular cross-section steel bar having oppositely located relieved precision-ground V-grooves or ways **45, 46** with included angles of approximately 46°.

Supporting the master brush **17** as by a screw **47** is an electrically insulative block **48** fastened to the carriage **14**, as by screws **49** and, following alignment, by dowel pins **50**. The wire-wound linear master card **19** is mounted with its longitudinal axis parallel to that of the rail so that the brush **17** will make good contact throughout the full range of travel of the carriage.

In operation the clearance between the four carriage rollers and the rail grooves is adjusted to approximately zero and the perpendicular component **22** of the camming force is carried by the rollers **31, 32**. Because of the high antifriction qualities of the ball-bearing-mounted carriage rollers acting against the hardened V-grooves in the guide rail, the friction loading is so low that resistance to carriage motion arises mainly from gravitational forces urging the carriage follower roller into contact with the cam. Loadings on the carriage rollers **33, 34** are generally normal to the top of the carriage but are negligibly low for cam approach angles up to 60° due to the substantially frictionless operation of the device. Lost motion is also negligible when the device has been properly designed, constructed and adjusted as hereinbefore outlined. While a rotary plate cam has been chosen for purposes of description, it is clear that the same principles apply in the use of cams designed for rectilinear motions. It has been found desirable to make use of large slopes of cam approach angles to provide a multiplication between resistance card length and master brush travel distance. The present invention by substantially eliminating slide friction makes possible the regular use of cams having approach angles of 60° and which may be increased, if necessary, to approximately 75° before friction and gravitational forces become limiting factors.

Various changes may be made in the form of invention herein shown and described without departing from the spirit of the invention or the scope of the following claims.

What is claimed is:

1. In a cam-actuated device for continuously and accurately varying resistance to be included in an electrical circuit, a fixed elongated linear resistor, an elongated guide having opposite side walls paralleling the resistor and provided with parallel grooves one in each of said side walls, a carriage having antifriction rollers disposed in said grooves and spaced to closely engage said side walls, a brush mounted on said carriage and in contact with said resistor, an antifriction cam follower mounted on the carriage intermediate of said rollers, a cam rotatable about an axis normal to the longitudinal axis of said guide and adapted to engage said follower, whereby the brush may be moved without lost motion across the entire length of the resistor in a manner exactly reproducing a motion determined by the contour of said cam.

2. In a cam-actuated device for continuously and accurately varying resistance to be included in an electrical circuit, a fixed elongated linear resistor, an elongated guide having opposite side walls paralleling the resistor and provided with parallel grooves one in each of said side walls, a carriage having antifriction rollers disposed in said grooves and spaced to closely engage said side walls, said grooves and the peripheries of said rollers being V-shaped in cross section, a brush mounted on said carriage and in contact with the resistor, an antifriction cam follower mounted on the carriage intermediate of said rollers, a cam rotatable about an axis normal to the longitudinal axis of said guide and adapted to engage said follower, whereby the brush may be moved across the resistor in a manner exactly corresponding to a motion determined by the contour of said cam.

3. In a cam-actuated device for continuously and accurately varying resistance to be included in an electrical circuit, a fixed elongated linear resistor, an elongated guide rail having opposite side walls paralleling the resistor and provided with parallel V-shaped grooves one in each of said side walls, a carriage plate having antifriction rollers on one side disposed in said grooves and spaced to closely engage said side walls, an antifriction cam follower mounted on the opposite side of the plate and offset therefrom, a brush mounted on the carriage plate and engaging the resistor, a cam rotatable about an axis normal to the longitudinal axis of said guide rail and adapted to engage said follower, whereby the brush may be moved across the length of the resistor in a manner exactly corresponding to a motion determined by the contour of said cam.

4. In a cam-actuated device for varying the amount of resistance to be included in an electrical circuit in order to produce a predetermined cyclical variation of voltage in said circuit, an elongated fixed linear resistor, an elongated guide rail having opposite side walls paralleling the resistor and provided with V-shaped grooves one in each of said walls, said grooves being relieved along the bottom portion thereof, a carriage plate having a substantially U-shaped cross section, a plurality of antifriction V-shaped rollers mounted on one side of said plate for rotation in the grooves and in zero clearance contact with said side walls, an antifriction cam-follower mounted on the opposite side of the plate and offset therefrom, a brush mounted on the carriage and resiliently urged to contact the resistor, a cam rotatably mounted about an axis normal to and intersecting the longitudinal axis of said guide rail and adapted to engage said cam-follower, whereby the rate of movement of the brush across the resistor may be varied in accordance with the contour of said cam.

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