March 3, 1964 J. R. KLEMM 3,123,792

SWITCH-RHEOSTAT

Filed March 18, 1963

Fig. 1.

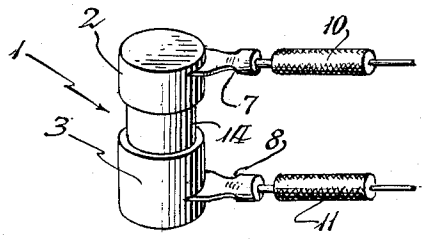


Fig. 2.

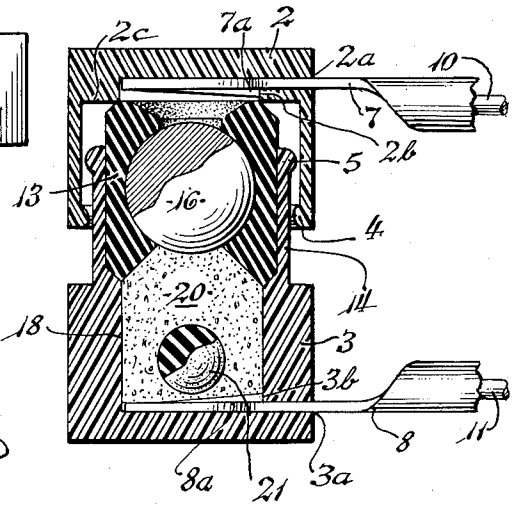


Fig. 4.

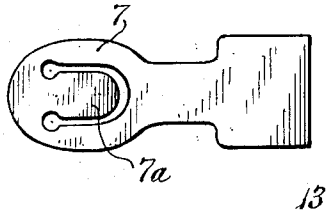
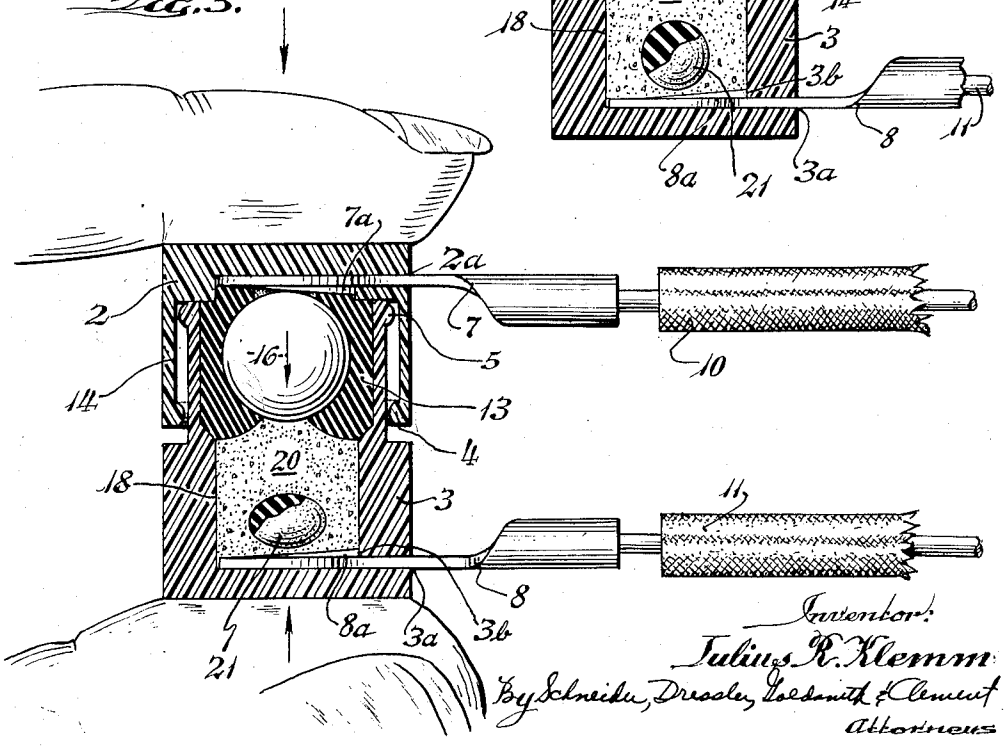


Fig. 3.



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SWITCH-RHEOSTAT

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This invention relates to a switch-rheostat assembly and, particularly, to a pressure sensitive device in which initial operation thereof will close the switch, and the continued application of pressure will vary the resistance of the device.

A switch-rheostat of the type that will respond to slight changes in pressure is particularly useful with games in which a variation in electrical current is desirable for varying the speed of such toys as electric trains or model racing cars. To be acceptable, such a device must have a long life and be capable of hard usage since it is to be handled by youngsters. The switch-rheostat to be marketable must at the same time be inexpensive to manufacture and sufficiently sensitive so that it will respond to slight changes in pressure. This sensitivity will minimize, if not eliminate, finger fatigue. While it is particularly adaptable to racing games in which reasonably accurate speed control is a factor, it is not limited to such a use.

It remains to note that the device is designed so that it will automatically be returned to the "open" position when the finger pressure is released to prevent the switch from remaining in the "on" position.

In accordance with the present invention, there is provided a housing assembly within which are disposed a pair of spaced contacts. To complete the circuit, there are interposed between the contacts a switch member and an electrically conductive material, the resistance of which will vary in accordance with the pressure applied thereto. An increase in pressure imposed on the electrically conductive material acts to lower the resistance and thereby increase the current flow to the article being controlled thereby, and conversely a decrease in pressure increases the resistance and decreases the current flow. In the case of a toy racing car, the speed will be varied depending on the pressure applied by the operator.

In the instant case, one of the contacts is resiliently biased out of engagement with the switch member whereby when the switch is not operated it will remain in the "open" position. When the spaced contact is moved into engagement with the switch member, the circuit is closed between the contacts wherein current flows from the one contact through the ball switch and electrically conductive material to the other contact. The application of additional pressure compresses the electrically conductive material to reduce the resistance thereof and correspondingly increase the current flow through the switch-rheostat. When the pressure is released from the device, the contact previously retained in engagement with the switch member is moved away therefrom to open the switch and the pressure imposed by the switch member on the electrically conductive material is released with a corresponding increase in resistance. When carbon granules are used as the electrically conductive material, a resilient compressible member is disposed within the recess containing the granules. When the granules are compacted, this member will compress and when the pressure on the granules is released the compressible member expands to return the granules to their uncompacted condition.

The structure by which the above and other advantages of the invention are attained will be described in the following specification, taken in conjunction with the accompanying drawings illustrating a preferred structural embodiment of the invention, in which:

FIGURE 1 is a perspective view of a switch-rheostat assembly incorporating the present invention;

FIGURE 2 is a cross-section of the device illustrated in the switch "open" position;

FIGURE 3 is a cross-sectional view similar to FIGURE 2, but showing the switch closed and the electrically conductive material in a compacted condition; and

FIGURE 4 is a plan view of one of the contact members.

As illustrated in FIGURE 2, the novel switch-rheostat embodying the present invention is made up of a plastic housing **1** consisting of readily separable sections **2, 3**. The housing is of a molded construction in which the upper section **2** is formed with an inwardly extending annular lip **4**, and the lower section **3** is formed with an outwardly extending lip **5**. The inner diameter of the inwardly extending lip **4** is less than the outer diameter of the outwardly extending lip **5** to prevent the halves from separating once the device is assembled. The housing is sufficiently resilient to permit enough relative movement therebetween to assemble the two housing sections. However, once the device is assembled, the interengaging lip portions act to prevent separation of the housing sections during normal usage.

The housing sections **2, 3** are each provided with slits **2***a*, **3***a*, respectively, to receive contact members **7, 8**. The other ends of the contacts **7, 8** are soldered or otherwise secured to leads **10, 11**, respectively. The ends of each of the contacts extending into the housing sections are formed with a punched tongue portion **7***a*, **8***a* that is adapted to engage with the inner wall **2***b*, **3***b* of housing sections **2, 3**, respectively. The tongue prevents removal of the contact from its respective housing once it is assembled in position (see FIGURES 2 and 4).

The sections **2, 3** of the housing **1** are maintained in the spaced position shown in FIGURE 2 by a sleeve **13** made of an elastomeric non-conductive material. The sleeve **13** is fitted into the upstanding tubular portion **14** of the lower housing **3** and extends above the top thereof wherein it engages an inner wall **2***c* of housing section **2**. The resilient sleeve **13** defines a substantially spherical cavity in which is located a ball or switch member **16**. The upper portion of the sleeve extends above the ball and biases the housing section **2**, and contact member **7** out of engagement with the ball **16**. Thus, when the switch-rheostat is in the position shown in FIGURE 2, i.e., the inoperative position, the circuit between the contact members **7, 8** is open.

The lower portions of the sleeve **13** and ball **16** form with the lower housing **3** a cavity or recess **18** in which is located an electrically conductive material, such as a plurality of carbon granules **20**. The granules **20** are sealed in the recess by the sleeve **13** and ball **16** which thus gives the device a long life since the carbon granules will be positively retained in the recess at all times. The granules may be of any suitable size and shape, and commercially available configurations are usable in this device. The quantity of granules located in the recess is such as to substantially fill the recess when in a loose or uncompacted condition.

When the switch-rheostat is operated, pressure is applied as shown in FIGURE 3 against the upper housing section **2**. During the movement from the position shown in FIGURE 2 to that shown in FIGURE 3, the downward movement of the upper housing section moves the contact **7** into engagement with the switch member **16** to close the circuit between the leads **10, 11**. The application of additional downward pressure against the upper housing section urges the ball **16** downwardly to compress the lower portion of the sleeve **13** and compact the carbon granules **20** located in the recess. The resistance variation in the carbon granules is obtained by varying the contact resistance therebetween so it can be seen that the application of pressure to compact the granules through the applica-

tion of pressure against the ball and sleeve will reduce the resistance of the carbon granules. The built-in resiliency of the sleeve **13** will return the ball to the position shown in FIGURE 2 when the finger pressure is released from the housing. The pressure against the granules is thus released to allow them to return to their uncompacted condition. The interface relationship between the carbon granules will tend to return them to the uncompacted state when the switch returns to the "off" position.

To facilitate the return of the carbon granules to the uncompacted condition, a resilient compressible ball member **21** may be located in the recess **18** containing the carbon granules. When the granules are compacted by the compressing action exerted by the ball and sleeve, the granules **20** distort the compressible ball **21** as shown in FIGURE 3. This action sets up a reaction force tending to expand the ball when the pressure thereon is released. When the pressure applied to the upper housing section is reduced or eliminated completely, the compaction force acting on the granules is correspondingly changed, thus allowing the compressible member to return to its normal configuration. During this latter movement, the granules in the recess are loosened up, which increases, the resistance thereof. For example, the resistance can be set to vary between 500 and 5 ohms, depending on the quantity of carbon granules and the pressure applied thereto.

Another advantage of this device is that the switch will be turned off if it is accidentally held in the normally closed position for an inordinate length of time. While the theory upon which this is based is not completely understood, the continued application of heat to the unit, due to current flow, results in expansion of internal parts, which breaks the contact between the switch member **16** and the upper contact **7**.

While a particular embodiment has been described and illustrated, it is to be understood that the invention is not so limited. For example, the switch member and rubber seal supporting the same could be of any suitable design, and other equivalent means could be employed for resiliently supporting the switch member in place in the device. Other modifications could include the replacing of the compressible ball in the recess with a spring-biased plunger, or other mechanism which would yield in response to the pressure of the compacted granules and would expand upon release of said pressure to return the granules to the uncompacted condition. Similarly, the switch-rheostat could employ other electrically conductive materials that would vary in resistance according to the pressure applied thereto, such as foam plastic or rubber impregnated with carbon.

It is, of course, intended to cover by the appended claims all such modifications and embodiments that fall within the true spirit and scope of the invention.

I claim:

1. A switch-rheostat comprising a pair of telescopically and slidably arranged housing sections, means on each of said sections cooperating to prevent inadvertent separation thereof, the first of said sections defining a recess, particulate electrically conductive material in said recess, a first contact member in said first section in electrical contact with said material, a conductor member in said first section adjacent said material, a second contact member in the second housing section, and a resilient sleeve in said first housing section and supporting said conductor member relative to said material and said second contact member in spaced relationship with said conductor member, said second housing section being slidable axially whereby said second contact member first will engage said conductor member to close the circuit between the contact members and further movement thereof will compress said material to decrease the resistance thereof.

2. The switch-rheostat of claim 1 in which said housing sections are cylindrical in configuration and said means comprises an external annular bead on said first housing section and an internal annular bead on said second housing section.

3. The switch-rheostat of claim 1 in which said conductor member comprises a metal ball.

4. The switch-rheostat of claim 3 in which said sleeve is open-ended and disposed coaxially of said first housing section, said sleeve snugly encasing said ball and extending beyond the extremities thereof.

5. The switch-rheostat of claim 1 in which resilient compressible means is positioned within said material for decompressing said material upon release of said second housing section.

6. A switch-rheostat comprising a pair of opposed telescopically and slidably arranged cylindrical housing sections, an annular external bead on the bottom section, an annular internal bead on the top section, said beads cooperating to prevent inadvertent separation of said sections, said bottom section defining a recess, a plurality of carbon granules in said recess, a first contact member in said bottom section adjacent the bottom edge thereof and in electrical contact with said carbon granules, an open-ended tubular elastomeric sleeve positioned in said bottom section above said carbon granules, a metal ball encased in said sleeve so that the top and bottom edges of said sleeve extend beyond said ball, said ball and the bottom portions of said sleeve cooperating to afford a seal for retaining said granules in said recess, a second contact member in said top section adjacent the top edge thereof, the top edges of said sleeve normally retaining said second contact member in spaced relation with said metal ball, said top section being downwardly movable whereby said second contact member first contacts said metal ball to close the circuit between said contact members and further movement thereof causes said metal ball to compress said carbon granules to vary the resistance thereof, and a compressible ball positioned in said carbon granules for decompressing said granules upon release of said top section.

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