June 27, 1967 R. R. THOMPSON ET AL 3,328,740

SINGLE PILE FOOT CONTROLLER

Filed Oct. 18, 1965 2 Sheets-Sheet 1

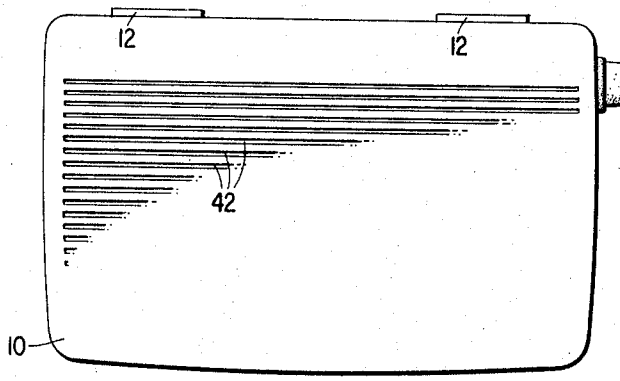

Fig.1

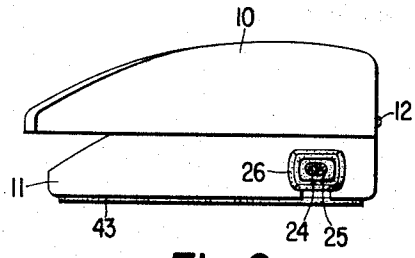

Fig.2

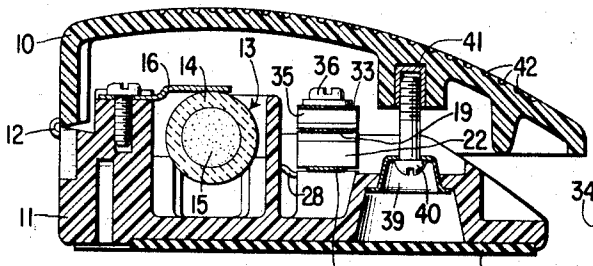

Fig.5

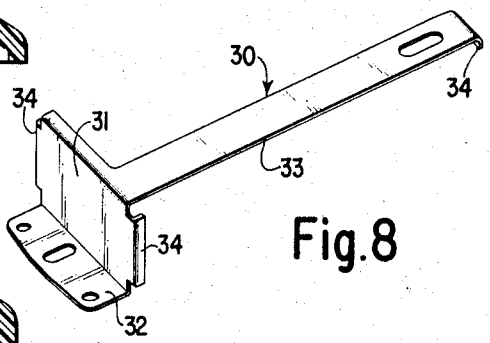

Fig.8

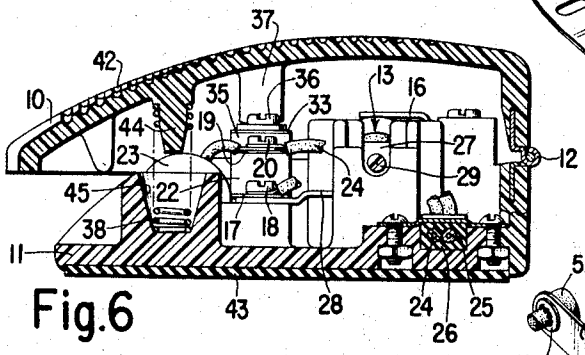

Fig.6

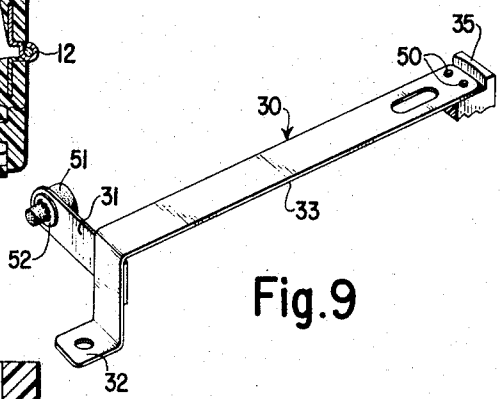

Fig.9

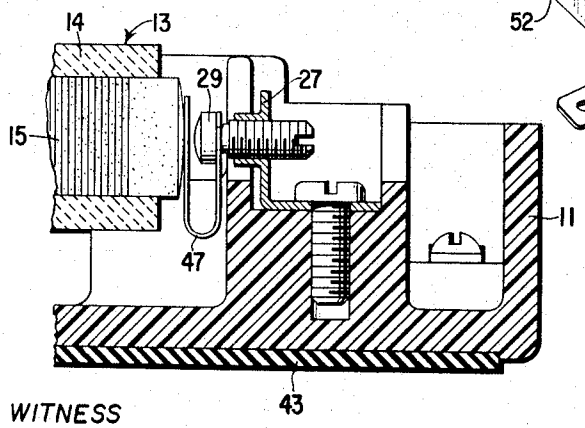

Fig.7

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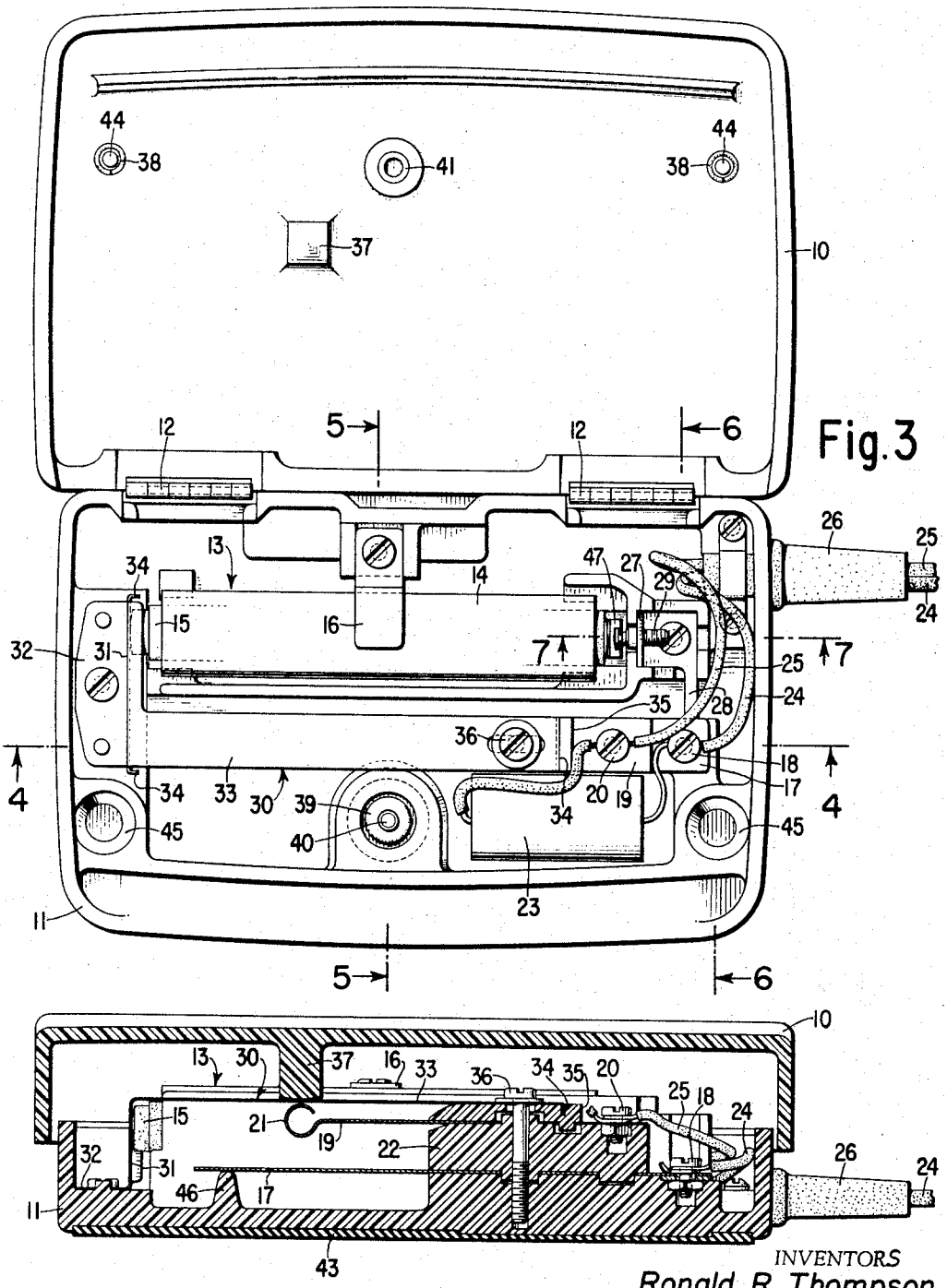

Fig.3

Fig.4

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SINGLE PILE FOOT CONTROLLER

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3 Claims. (Cl. 338—108)

This invention relates generally to controllers for electric motor circuits and more particularly to controllers embodying carbon pile variable resistors for starting, stopping and controlling the speed of electric motors.

Controllers of this general type are particularly adapted for controlling electric sewing machine motors and are well known in the art as shown, described and claimed in United States Patents No. 2,371,772, granted to J. M. Naul on Mar. 20, 1945, No. 2,384,772, granted to C. R. Schenk on Sept. 11, 1945 and No. 2,536,012, granted to E. P. Turner on Dec. 26, 1950; all assigned to the same assignee as is the present application.

An object of the present invention is to provide an improved variable resistance controller of simple and rugged construction which is not readily subject to malfunction.

Another object of the present invention is to provide a controller with a carbon pile resistance element and a single leaf spring actuator for varying the resistance of the carbon pile as a function of deflection of the actuator.

Still another object of the present invention is to provide a controller with a carbon pile resistance element in fixed position therein and a single leaf spring actuator retained at its ends and having a transversely bent portion providing a pressure face deflectable for varying the pressure applied to the carbon pile for varying the resistance derived therefrom.

Another object of the present invention is to provide the foregoing controller in which the actuator thereof may be formed from a single sheet of metallic material or may be constructed from two pieces of standard strip stock.

The present invention contemplates a controller for electric motors, comprising a base, a carbon pile resistor connected to the base and supported thereby, a leaf spring actuator connected at its ends to the base and constructed to provide a transverse pressure face adjacent one end in contact with the carbon pile for applying pressure thereto, and means engaging the actuator intermediate the pressure face and the end opposite from such face for deflecting the actautor to vary the pressure applied thereto and the resistance derived therefrom.

The foregoing and other objects and advantages will appear more fully hereinafter from a consideration of the detailed description that follows, taken with the accompanying drawings wherein two embodiments are illustrated by way of example. It is to be expressly understood, however, that the drawings are for illustration purposes only and are not to be construed as defining the limits of the present invention.

FIGS. 1 and 2 are top plan and side elevation views, respectively, of a controller made in accordance with the present invention,

FIG. 3 is an enlarged plan view of the novel controller of FIGS. 1 and 2 with the casing cover swung away to expose the component parts enclosed therein,

FIG. 4 is a longitudinal sectional view taken on line 4—4 of FIG. 3 with the casing cover disposed in its normal position for operation,

FIGS. 5 and 6 are lateral sectional views taken on lines 5—5 and 6—6, respectively, of FIG. 3 with the casing cover disposed in its normal position for operation,

FIG. 7 is an enlarged fragmentary sectional view taken on line 7—7 of FIG. 3 illustrating a carbon pile pressure adjusting means,

FIG. 8 is a perspective view of the novel carbon pile pressure actuator, and

FIG. 9 is a perspective view of a modified form of the pressure actuator shown in FIG. 8.

Referring now to the drawings and particularly to FIGS. 1 and 2, a controller may have a casing comprising a hollow cover or foot pedal **10** pivotally connected along its rear edge to the rear edge of a hollow base **11** by a pair of spaced hinges as shown in FIG. 3. Cover **10** and base **11** are of a substantially rigid non-conductive or insulating material, such as a synthetic resin, and are preferably molded to provide various mounting surfaces, recesses and protuberances required for installing various components, as hereinafter will be discussed. A controller casing of the above type is shown and described in a copending United States patent application Ser. No. 490,590, filed Sept. 27, 1965, and assigned to the same assignee as the present invention and to which reference may be had for a more complete understanding thereof.

As shown in FIG. 3, a variable resistance element **13** is disposed in the rear portion of base **11**, being supported at its ends and clamped in position by a finger type sheet metal retainer **16** connected to the base **11** by a single threaded fastener. Resistance element **13** is preferably of the carbon pile type comprising a rigid insulating sleeve **14**, of ceramic or other acceptable dielectric material, which houses a carbon disc pile **15**.

As is also shown in FIG. 4, a pair of elongated leaf spring contacts **17** and **19** are disposed one above the other in base **11**, forwardly of and substantially parallel to resistance element **13**. Contact **17** is supported at its ends by base **11**, and is provided with a terminal **18** at one of its supported ends. Contact **19**, shorter than contact **17**, is provided with a terminal **20** at one end and may be rolled at its other end **21**. A block **22** is disposed between the terminal ends of contacts **17** and **19** for spacing the contacts and supporting the terminal end of contact **19**. The rolled contact end **21** is disposed in spaced relation with and is free to move into and out of engagement with contact **17** when contact **19** is deflected. Contact **17** is supported at its free end by a boss **46** formed on the base **11**. This double support for contact **17** enables it to exert a stronger pressure with less material than by other means and still permit over-travel of the cover **10** after full speed operation is reached.

A condenser **23**, disposed in base **11** forwardly of the terminal ends of contacts **17** and **19**, is connected to terminals **18** and **20** to absorb energy incident to sparking between all operating contacts and thus to reduce radio-frequency interference as is well known. A pair of insulated conductors **24** and **25**, of a controlled motor circuit (not shown) enter base **11** through an elongated tubular insulating grommet **26** and are connected to terminals **17** and **19**, respectively, by the respective terminals **18** and **20**. Although terminals **18** and **20** are each shown as comprising a nut and bolt, in accordance with common practice, each such bolt may threadedly engage the associated contact.

It should be readily understood that contacts **17** and **19** provide a normally open circuit switch which is closed, when maximum speed of the controlled motor (not shown) is desired, to short circuit or bypass resistance element **13**.

An L-shaped leaf spring bracket or bracket portion **27**, shown in detail in FIG. 7, is connected to base **11** in spaced face to face relation with one end of resistance element **13**, and has a leg **28** which provides a birdge that is connected to contact **17**. It should be realized that contact **17** and bracket **27** may be made, alternatively, as a

single unit or as individual leaf spring elements. A pressure adjustment element **29** is threadedly supported by bracket **27** and has a U-spring portion **47** which engages the adjacent end of the carbon pile **15** to transmit pressure thereto and to complete an electric connection from resistance element **13** to conductor **24** through bracket **27** and terminal **18**. Element **29** moves axially, when threaded into **27**, to vary and adjust initial resilient pressure on carbon pile **15** to derive desired resistance from element **13** when the controller is in its unoperated condition and provides, through U-spring portion **47**, means for compensating changing lengths of pile **15** due to heating and wear. It will also be noted that the U-spring **47** provides a resilient stop for the pile **15** which, for initial operational movement of the cover **10**, effects a low rate of pressure buildup on the pile **15** which greatly improves the low speed control capability.

As shown in FIGS. 3, 4 and 8, a leaf spring type actuator **30** is provided in base **11** for varying pressure applied to the carbon disc pile **15** in response to movement or actuation of the cover or foot pedal **10**. More specifically, actuator **30** is formed to provide a pressure face or portion **31** disposed across the end of element **13**, opposite from adjustment element **29**, and in contact with the carbon pile **15**. Pressure face **31** has a flange **32** extending from its bottom edge that is connected to base **11**, and an elongated spring leg **33** extending from its upper edge, substantially parallel to and offset from element **13**, over contact **19** toward terminals **18** and **20**. Thus, in effect, actuator **30** is merely an elongated leaf spring having an enlarged portion **31** adjacent one end and is formed or bent so the portion **31** is disposed in a transverse plane and offsets flange **32** from leg **33** along such transverse plane.

A block **35** is disposed between the end of leg **33** and the terminal end of contact **19** to space the free contact end **21** from leg **33**. A threaded fastener **36** is provided to clamp, with blocks **22** and **35**, the end of leg **33** and the terminal ends of contacts **17** and **19** to base **11**. As shown in FIG. 4, blocks **22** and **35** are also insulators between leg **33** and contacts **17** and **19**, and have keys extending through the said contacts to provide an interlock with base **11**. One such key on each side of block **22** provides insulation for fastener **36** from contacts **17** and **19**.

A flange **34** may be provided along the edges of the pressure face **31** between flange **32** and leg **33** for added rigidity, and another such flange may be provided at the end of leg **33** which extends into block **35** for positive interlock. It should be readily understood that leg **33** and contact **19** provide a normally open circuit switch in series with resistance element **13** to prevent unnecessary heating of the element **13** when the controller is unoperated and to disconnect electrically the controller from the electrical supply line as a safety feature.

It will be seen from FIG. 4 that block **35** is slidable to a degree with respect to block **22** and movement of block **35** compensates for linear and angular tolerance buildup and provides a coarse pile pressure adjustment.

A modified form of the actuator **30** of FIG. 8 is shown in FIG. 9. In this form the parts having similar function to those of FIG. 8 carry the same reference numbers. Referring to FIG. 9, it will be seen that the actuator **30** may be made in two parts **31** and **33**, spot welded together and this may be desirable as a lower cost item since standard strip stock can be used in this form. Furthermore, the end of the leg **33** may be anchored to the block **35** by projections **50** formed in the block **35** and engaged by simple apertures made in the leg **33** as shown. If desired, a contact **51**, preferably made of carbon, may be secured to the pressure portion **31** by a push nut **52** pushed onto a reduced diameter thereof.

Cover or foot pedal **10** has a pressure pad **37** which engages leg **33**, intermediate its ends and above the free end **21** of contact **19**. A spring **38** is provided in the front portion, at each end, of the casing for biasing the cover **10** to pivot away from base **11**. The springs **38** are pressed over raised bosses **44** on the inner surface of the cover **10**. The spring dimensions are such that the springs **38** hold themselves in place by helical contraction around the bosses **44** and are thus self-retaining. As the cover **10** is closed, the springs **38** are guided to their flat seats by the sides of conical recesses **45** formed in the base **11**. As best seen in FIG. 5, such pivotal movement in response to the bias of springs **38** is limited by a self-locking screw **40** threadedly engaging an insert **41** in cover **10** and having a head engaged by a dished washer **39** movably disposed in a recessed opening in base **11**. Cover **10** is adjusted to a desired unoperated position, by adjusting screw **40** to a position where pressure pad **37** deflects leg **33** to a predetermined gap distance from free end **21**.

To prevent the controller from sliding when in use, cover **10** may have a plurality of parallel grooves **42** in its outer surface, and a friction pad **43** may be applied to the bottom surface of base **11**.

In operation, downward pressure on cover **10** causes it to pivot on hinges **12** moving pressure pad **37** to deflect or bend leg **33** into engagement with the free end **21** of contact **19**. This initial deflection of leg **33** establishes a closed resistance path between conductors **24** and **25** comprising terminal **18**, leg **28** and bracket **27**, pressure adjustment element **29**, U-spring **47**, resistance element **13**, actuator **30**, contact **19** and terminal **20**.

As spring leg **33** is progressively deflected, by downward movement of pressure pad **37**, the axial distance between its clamped end in block **35** and the pressure face **31** progressively shortens. This causes the pressure face **31** to move toward element **13** and exert progressively increasing pressure on carbon pile **15** for reducing the resistance thereof accordingly.

The characteristic of the pile resistance as a function of pile pressure is non-linear with the resistance change rate being large at low pressures and small at high pressures. The characteristic of the pile pressure as a function of cover movement is also non-linear with the pressure change rate being small at the beginning of cover movement and increasing with further cover movement. These two non-linear functions are mutually compensating, resulting in a substantially linear characteristic of resistance as a function of cover movement, which characteristic is desirable for good motor speed control.

Contact **19** is common to both the resistance and bypass flow paths between conductors **24** and **25**, and is deflected simultaneously with leg **33** when the resistance path is established. Leg **33** and contact **19** approach maximum deflection, in response to movement of pedal **10**, as resistance of carbon pile **15** approaches its minimum. Further movement of pedal **10** causes leg **33** to completely deflect, and the free end **21** of contact **19** to engage contact **17** to establish the bypass path for maximum speed operation of the controlled motor (not shown).

Upon reduction of pressure on pedal **10**, the sequence of operation of the components of the controller is reversed.

Contacts **17** and **19** and actuator **30** are stamped or cut from sheet metal and then formed and thus are reduced to their simplest single leaf spring form to substantially eliminate malfunction and wear normally attendant with assemblies of movable actuating parts. Further stated, a carbon pile resistor is provided with an actuator for varying the pressure applied to the carbon pile and vary the resistance derived therefrom as a function of deflection of the actuator. Although but two embodiments of the invention has been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes may also be made in the design and arrangement of parts without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

Having thus described the nature of the invention, what we claim herein is:

1. A controller for electric motors, comprising:

(a) an insulating base;

(b) a single carbon pile resistor supported on the base;

(c) a flat sheet metal leaf spring actuator formed with a single elongated leg portion disposed parallel to and laterally offset from said pile resistor and lying in a first plane;

(d) means securing one end of said leg portion to said base;

(e) means at the other end of said leg portion providing a portion bent towards the base and lying in a second plane transverse to the first plane;

(f) means securing the free end of the transversely bent portion to said base;

(g) the bent portion being formed with an offset pressure portion in contact with one end of the pile resistor for applying pressure thereto;

(h) single means engaging and deflecting the single leg portion to vary the pressure applied by the pressure portion to the pile resistor and to vary the resistance thereof;

(i) contact means engaging the end of the pile resistor opposite from the pressure portion of the actuator

providing an electrical connection to the resistor; and

(j) a contact supported by the base in normally spaced relation to the actuator and contacted by the leg portion when initially deflected to provide another electrical connection to the pile resistor.

2. A controller in accordance with claim 1 wherein the actuator including the pressure portion is formed from a single piece of sheet metal.

3. A controller in accordance with claim 1 wherein the leg portion and the bent portion of the actuator are formed from a single piece of sheet metal and the pressure portion is formed from a separate piece secured to the bent portion.

References Cited

UNITED STATES PATENTS

2,371,772	3/1945	Naul	338—108
2,384,772	9/1945	Schenk	338—108
2,536,012	12/1950	Turner	338—108
2,561,556	7/1951	Bell	338—108
2,620,419	12/1952	Sharenow et al.	338—108
2,988,720	6/1961	Voorlas	338—113

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