May 27, 1958 J. DI GIROLAMO ET AL 2,836,691

COMBINATION VARIABLE RESISTOR AND SWITCH

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Fig. 1.

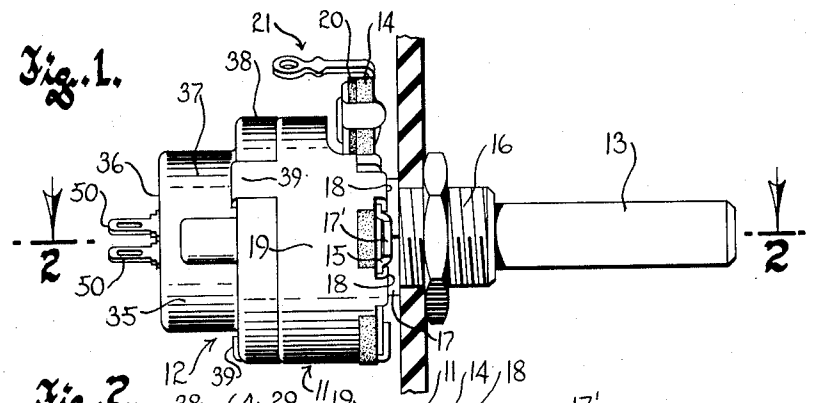


Fig. 2.

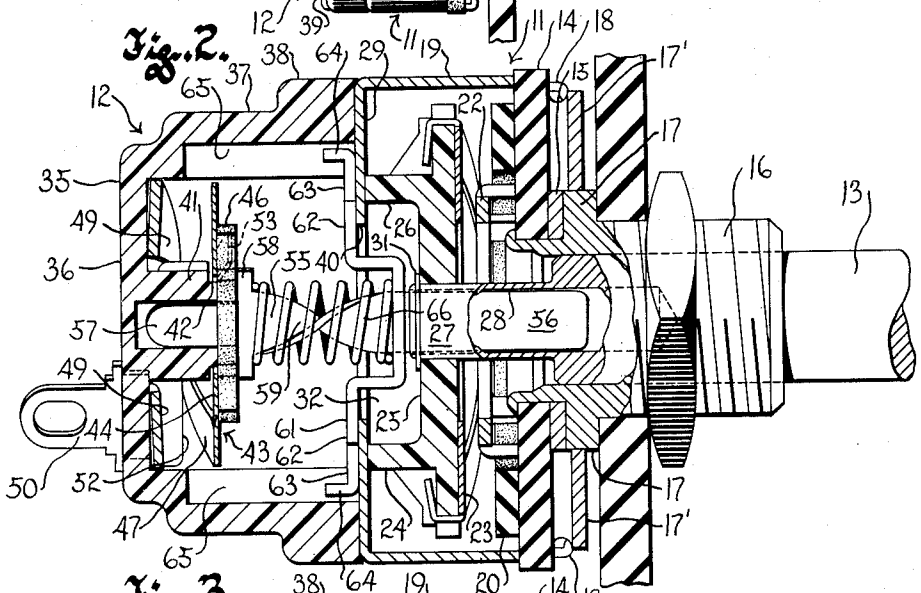
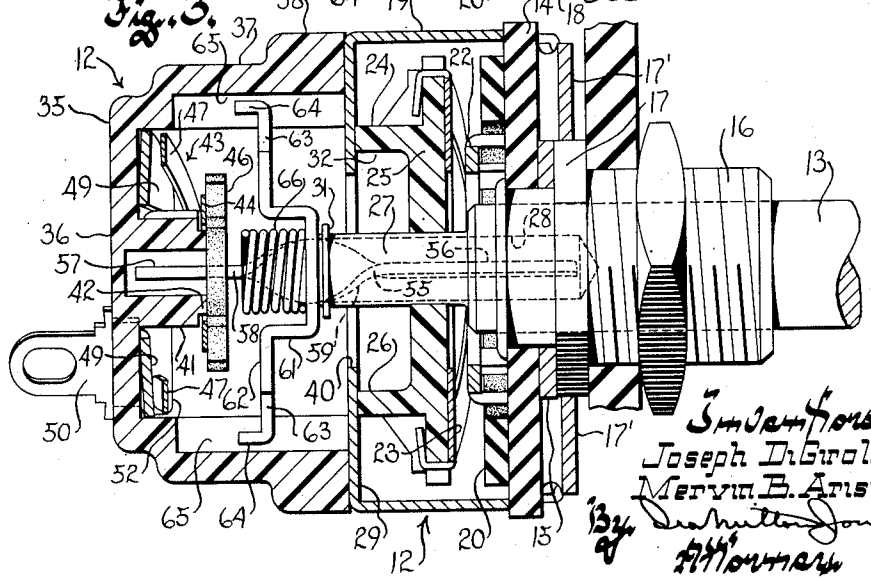


Fig. 3.

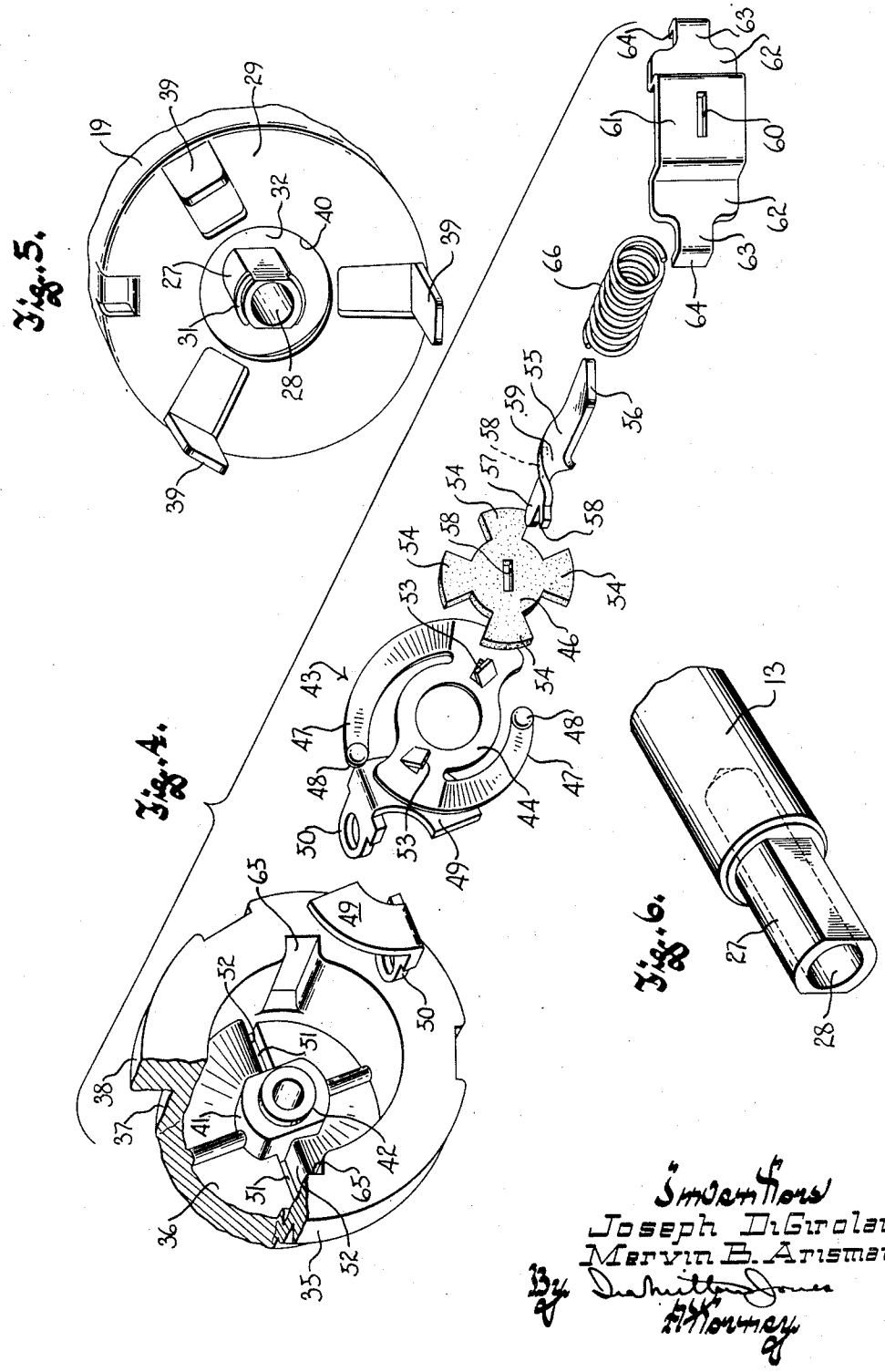


Inventors
Joseph DiGirolamo
Mervin B. Arisman
By
Attorneys

May 27, 1958 J. DI GIROLAMO ET AL 2,836,691

COMBINATION VARIABLE RESISTOR AND SWITCH

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Inventors
Joseph DiGirolamo
Marvin B. Arisman
By Smith & Jones
Attorneys

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COMBINATION VARIABLE RESISTOR AND SWITCH

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Fig. 7.

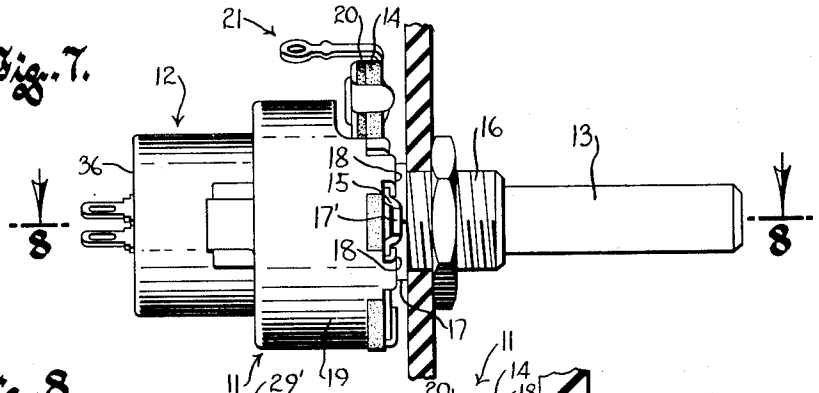


Fig. 8.

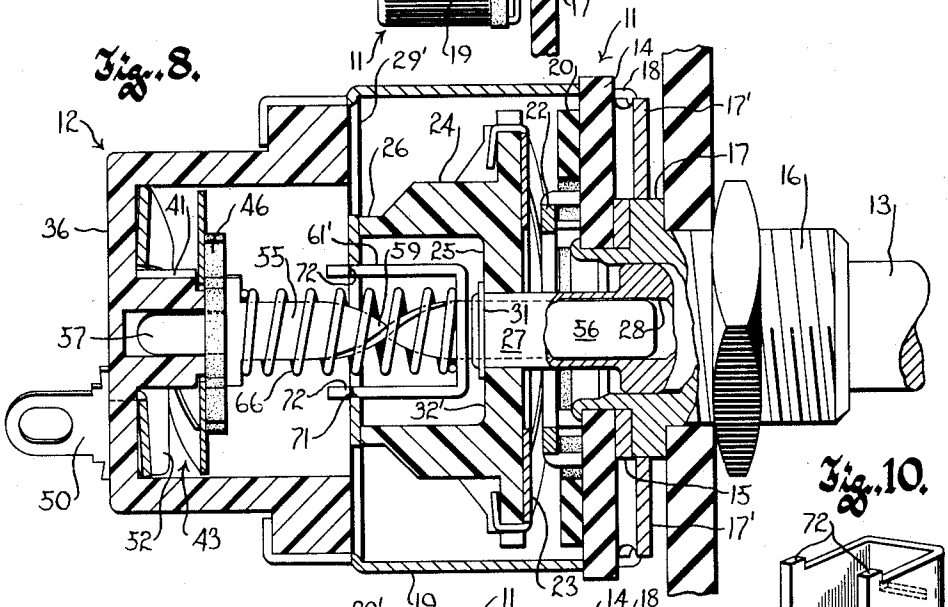


Fig. 10.

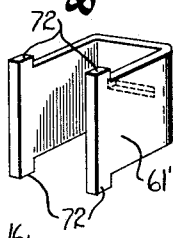


Fig. 9.

Inventors
Joseph Di Girolamo
Mervin B. Arisman
By
Attorney

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COMBINATION VARIABLE RESISTOR AND SWITCH

Joseph Di Girolamo, Mishawaka, and Mervin B. Arisman, Elkhart, Ind., assignors to Chicago Telephone Supply Corporation, Elkhart, Ind., a corporation of Indiana

Application June 18, 1956, Serial No. 591,990

7 Claims. (Cl. 201—55)

This invention relates to controls for radio and television receivers and refers more particularly to a combination variable resistor and electric switch.

Combination controls of this type are not broadly new. Ordinarily the two units are arranged in tandem, with the switch mounted upon the back of the variable resistor. In combination controls of this type heretofore available, both the adjustment of the variable resistor and the opening and closing of the switch was effected by rotation of a single control shaft to which an appropriate knob was secured, the switch actuation being effected by a few degrees of rotation of the shaft at one limit of rotary adjustment of the resistor.

Usually these combination controls are employed as combined on-off switches for the receiver or other instrument and a volume or loudness control, with the switch actuation taking place at the lowest point in the gradient of volume regulation. Thus, it was impossible to turn off the switch without first adjusting the volume control to its lowest setting, and accordingly the volume control had to be reset each time the switch was turned on. This inconvenience, and particularly its attendant need for having to delay adjustment of the volume to the desired setting long ago led to the recognition that it would be desirable to have a combination control of this type wherein opening and closing of the switch could be effected without concomitantly changing the adjustment of the variable resistor. Accordingly, this invention has as its general purpose to provide a combination variable resistor and switch which achieves that objective.

More specifically, it is an object of this invention to provide a combination variable resistor and switch wherein opening and closing of the switch is accomplished by axial movement of a common control shaft, without in anywise affecting the position of adjustment of the variable resistor.

Still more specifically it is an object of this invention to provide a combination control unit of the character described wherein the opening and closing of the switch is effected by successive pushes on the common control shaft.

As those skilled in this art readily understand, compactness in a control of this nature is not only an end to be sought but in fact an inescapable necessity. Accordingly, it is another object of this invention to provide a combined variable resistor and switch which is characterized by exceptional compactness of its working parts and small overall size, despite the fact that a switch of the type in which the opening and closing operation is effected by axial shifting of an actuator requires more space than the more conventional type of switch wherein the opening and closing operation is produced solely by rotary motion of a control shaft or actuator.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more

particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate two complete examples of the physical embodiments of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a side elevational view of a combination variable resistor and electric switch embodying this invention;

Figure 2 is an enlarged longitudinal sectional view taken through Figure 1 on the plane of the line 2—2 and showing the switch in its open condition and the actuating mechanism therefor in its normal free position;

Figure 3 is a sectional view similar to Figure 2 but illustrating the switch actuating mechanism depressed and the switch contactor rotated into switch closing position;

Figure 4 is an exploded perspective view of the switch and its actuating mechanism;

Figure 5 is a perspective view of the rear aspect of the variable resistor with its switch holding tangs extended straight out and illustrating the adjacent rear end portion of the control shaft;

Figure 6 is a fragmentary perspective view of the control shaft per se;

Figure 7 is a side elevational view of a combination variable resistor and switch embodying this invention but having slightly modified switch actuating mechanism;

Figure 8 is an enlarged longitudinal sectional view through Figure 7 on the plane of the line 8—8 and illustrating the switch in its open condition and the switch actuating mechanism in its normal free position;

Figure 9 is a view similar to Figure 8 but showing the switch actuating mechanism depressed and the switch contactor rotated to its switch closing position; and

Figure 10 is a perspective view of one of the elements of the switch actuating mechanism.

Referring now particularly to the accompanying drawings in which like numerals designate like parts throughout the several views, the numeral 11 designates generally the variable resistor of the combination control instrumentality, having the switch, designated generally by the numeral 12, mounted upon its back. Two units are arranged in tandem and are operable by a common control shaft 13.

The variable resistor 11 is of conventional construction and comprises a flat base 14 of suitable insulating material. Overlying the front of the base 14 is a ground plate 15 which is held in place by a threaded thimble or bushing 16 having its rear portion received in aligning holes in the base and the plate, and so secured to the base that a portion of the ground plate is clamped between a non-circular flange 17 on the bushing and the front of the base. The ground plate 15 has diametrically opposite parts 17' thereof offset forwardly and sheared out to conform to the shape of the adjacent peripheral portions of the flange 17 so that the securement of the ground plate against rotation also serves to hold the thimble or bushing against turning.

The ground plate is held against turning by the interengagement of shoulders on its periphery with attaching tangs 18 projecting forwardly from the rim portions of a cup-like stamped metal cover 19 which coacts with the base 14 to provide a housing for the components of the variable resistor.

The thimble or bushing 16 provides means for mounting the entire control upon a panel as is customary, and the bore through the thimble or bushing slidably and rotatably mounts the control shaft 13. The inner end of the

shaft projects into the interior of the variable resistor housing, and the outer end of the shaft projects a distance forwardly out of the bushing to have a control knob, not shown, mounted thereon.

Concentric with the axis of the control shaft and mounted upon the inner face of the base is an annular flat resistance element **20** provided with the customary terminals indicated generally as at **21**. A central collector ring **22** also is provided to substantially nest within the annulus of the resistance element, and as is customary, the collector ring has a terminal similar to the terminals of the resistance element and generally located between the two terminals of the element.

A contactor **23** having spring fingers or paddles bearing upon the resistance element and the collector ring **22** is mounted upon a rotatable carrier **24** so that the contactor fingers traverse the resistance element and collector ring upon rotation of the carrier. The carrier **24**, which is preferably molded of suitable insulating material, has a substantially shallow cup shape, with an end wall **25** overlying the rear of the resistance element and an annular rearwardly projecting rim **26**, and the contactor **23** is fastened to the end wall **25** overlying the front face thereof. The carrier, of course, is mounted on the rear end portion **27** of the control shaft, which, for this purpose, is non-circular in cross section and is substantially smaller than that portion of the shaft which is slidably journaled in the thimble or bushing **16**. The shaft is also provided with a bore **28** which extends from its rear end, forwardly beyond the junction between the reduced inner end of the shaft and the rest of the shaft.

The spring tension of the contactor arms, of course, imparts a rearward end thrust onto the carrier **24** which is resisted by the engagement of the edge of the rim **26** with the adjacent inner face of the rear wall **29** of the cover **19**. To assure the desired freedom of adjustment and smooth operation of the resistor the edge of the annular wall **26** is smooth and lies in a single plane exactly normal to the axis of carrier rotation, and of course the inner face of the rear wall **29** must be smooth.

The control shaft **13** is slidably splined to the carrier **24** by virtue of the reception of its non-circular inner end portion **27** in a correspondingly shaped axial hole in the end wall **25** of the carrier. Consequently, rotation of the control shaft will be imparted to the carrier and hence to the contactor of the variable resistor without, however, interfering with free axial motion of the control shaft within limits. Outward or forward axial movement of the control shaft is limited by the engagement of a shoulder **31** on the rear end of the shaft with the bottom of the well **32** defined by the cup-shaped carrier, as shown particularly in Figure 2. The shoulder **31** is formed on the shaft after the shaft and carrier are assembled, by a suitable staking or upsetting operation.

Before leaving consideration of the variable resistor, attention is directed to the fact that the spring tension with which the contactor arms engage the resistance element and collector ring, is determined solely by the engagement of the rim **26** of the carrier with the rear wall **29** of the housing **19**. In this connection, it should be understood that the base **14** is at all times accurately positioned with respect to the rear wall of the housing since it is entirely possible to hold the axial dimension of the cylindrical side wall of the housing to very close tolerances.

The switch **12** which as noted hereinbefore, is mounted upon the back of the variable resistor, comprises a housing **35** molded of suitable insulating material and having a substantially flat rear wall **36** and a cylindrical side wall **37**. The side wall is provided with an outwardly enlarged rim **38** having circumferentially spaced notches in its periphery to receive tangs **39** extended rearwardly from the variable resistor housing and turned over at their ends, behind the rim, to thereby securely hold the switch housing to the rear of the resistor. As best shown in Figure 5, the tangs **39** are struck from the rear wall **29** of the resistor housing, which also has a relatively large round hole **40** coaxial with the well **32** in the carrier **24**.

Projecting inwardly from the flat rear end wall **36** of the switch housing is a central boss **41**, the inner end of which is reduced in diameter and provides a round pilot **42** for the contactor **43** of the switch. The contactor **43** has a hub portion **44** which is rotatably journaled on the pilot **42** and is confined between the forwardly facing shoulder **45** on the boss at its junction with the reduced pilot **42**, and a rotatable clutch plate **46** bearing flatwise against the forward end of the pilot. Diametrically opposite spirally formed spring arms **47** on the contactor **43** project toward the rear wall **36** of the switch housing, and have contact points **48** on their outer or free ends cooperable with a pair of diametrically opposite quadrant-like stationary contacts **49** on the inner surface of the rear wall of the switch, outwardly of the boss **41**. Flat terminal portions **50**, integral with the stationary contacts extend through, and are fixed in diametrically opposite slits **51** in the bottom or end wall **36** of the switch housing to provide means externally of the housing for connecting the switch in an electric circuit.

To achieve a snap action, the stationary contacts are slanted spirally forwardly from their radial edges which are adjacent to the slits **51**, toward the opposite radial edges of the contacts, and preferably that portion of the bottom of the switch housing upon which the contacts rest is correspondingly shaped so as to solidly support the contacts. Intermediate the stationary contacts, the bottom of the cup-shaped switch housing is not flat but is likewise shaped to provide a second pair of diametrically opposite forwardly slanting spirally shaped surfaces, each having its foremost edge adjacent to one of the slits **51** and defining an abrupt step **52** leading to the rearmost surface of the adjacent stationary contact. In addition to providing the desired snap action the steps **52** between the adjacent spiral quadrants also preclude retrograde rotation of the contactor, as will be readily apparent.

Switch opening and closing rotation is imparted to the contactor **43** by the clutch plate **46**, and for this purpose the contactor has a pair of oppositely inclined ears or lugs **53** projecting forwardly from its hub portion **44** to be received between arms **54** extending radially from the clutch plate. By virtue of the inclination of the drive lugs **53**, retrograde rotation of the clutch plate **46** is possible without affecting the position of the contactor **43**. Hence, although the clutch plate or drive arm **46** has both clockwise and counterclockwise rotation imparted to it by the switch actuating mechanism, only its clockwise rotation will be imparted to the switch contactor **43**, the contactor being held against retrograde or counterclockwise rotation at the completion of each adjustment thereof by the engagement of the extremities of its spring arms with the abrupt shoulders or steps **52** between adjacent spiral quadrants at the bottom of the cup-shaped housing.

Rotation is imparted to the clutch plate **46** by an elongated spiral actuator **55** supported jointly by the switch and the resistor in axial alignment with the control shaft **13**. This actuator is stamped from a strip of flat sheet metal and has flat front and rear end portions **56** and **57** respectively. The rear end portion **57** is reduced in width and passes rearwardly through a slit **58** in the center of the clutch plate **46** into a hole in the boss **41** coaxial with the control shaft. Shoulders **58** at the base of the reduced rear end portion of the actuator bear against the front face of the clutch plate **46**. Between its flat front and rear ends **56** and **57**, which, incidentally, do not lie in a common plane but are disposed at approximately 192° from one another, the actuator is twisted as at **59**.

The forward end portion **56** of the spiral actuator is slidably received in a slit **60** in a driver **61** preferably stamped from sheet metal and of generally U-shaped formation to provide a substantially large flat bight in which the slot **60** is formed. The opposite arms of the

driver are bent out as at **62**, parallel to the bight, and have reduced outward extensions **63**, the extremities **64** of which are bent rearwardly and are parallel to one another. The driver **61** extends diametrically across the switch housing and has the extremities **64** of its arms slidably received in inwardly opening diametrically opposite longitudinal grooves **65** in the side wall of the switch housing, so that the driver is non-rotatable but freely axially slidable in the housing. The grooves **65** open to the front of the switch housing but, of course, are closed by the adjacent rear wall **29** of the resistor housing so that the wall **29** serves to define the forward limit of axial movement of the driver **61**.

The driver is yieldingly urged to its forward limit of motion by a coil spring **66** encircling the twisted portion of the actuator and confined between the bight of the driver and the shoulders **58** on the spiral actuator. The spring **66** thus also serves to hold the clutch plate **46** snugly against the front of the boss **41** and the front face of the contactor **43**, and as clearly shown, the front end portion **56** of the actuator is freely received in the bore **28** of the control shaft. The actuator, therefore, is supported at one end by the shaft and at the other end by the hub **41** on the rear of the switch housing.

In the normal or free condition of the parts illustrated in Figure 2 the forwardly biased driver **61** is directly adjacent to the rear end of the control shaft **27**. Hence, it is engageable and shiftable rearwardly by the shaft upon inward axial motion thereof. The driver, however, is held by the engagement of its arms with the rear wall of the resistor housing from applying force upon the contactor assembly of the variable resistor. This assures against increasing the contact pressure between the rotatable contactor of the resistor and the resistance element by the switch spring **66**.

Operation

As will be readily understood rotation of the control shaft adjusts the variable resistor in the conventional manner, but by virtue of the slidably splined driving connection between the control shaft and the contactor carrier of the resistor, the control shaft is axially shiftable without affecting the position of adjustment of the variable resistor. Therefore, in any position of adjustment of the resistor the control shaft may be depressed or pushed in to actuate the switch, either to its "on" position or its "off" position, depending upon the condition of the switch at the time such inward axial displacement of the shaft is effected.

Inward axial movement of the control shaft is translated into clockwise rotation of the switch contactor by the spirally twisted actuator in the following manner: The rearward end thrust applied to the shaft is imparted to the driver **61** which is constrained to axial motion by virtue of the engagement of its extremities in the longitudinal grooves **65** in the switch housing. As the driver **61** is pushed in by the shaft, it slides along the twisted portion of the spiral actuator and as a result of such relative motion and the twist in the actuator, rotation is necessarily imparted to the actuator and accordingly, to the clutch plate **46**, and the contactor through its unidirectional driving connection with the clutch plate. The degree of such angular motion of the clutch plate **46** is sufficient to carry the contact points on the ends of the contactor arms angularly along the entire length of their respective spiral quadrants and cause them to snap over the edges of the steps **52** and onto the bottom of the next diametrically opposite set of spiral quadrants. Accordingly, with each successive push or inward displacement of the control shaft the switch contactor is advanced from one of its positions to another.

Attention is directed to the fact that the driver **61** is restrained against rotation in a manner which introduces a minimum of restraint or binding and practically assures free endwise movement of the driver. This desirable result flows from the fact that the extremities of the driver are slidably received in the grooves **65**, which, being formed in the plastic housing, are non-metallic.

Attention is also directed to the extreme compactness attained by the construction described and which flows particularly from the fact that a substantial portion of the driver, namely the bight portion thereof, projects through the rear wall **29** of the resistor housing into the interior of the resistor housing. Such projection of the driver into the housing is made possible by the fact that the driver is received within the rearwardly opening well defined by the rim on the back of the molded carrier **24**. Since the spring **66** must of necessity have substantial length, compactness is also achieved by having the forward end portion of the spring also normally received in the well **32** in the carrier **24**.

The embodiment of the invention illustrated in Figures 7 to 10 inclusive, in general corresponds to that described, but is not quite as compact axially and does not have the advantage of having the switch driver guided and restrained against rotation by non-metallic guide surfaces. Accordingly, the well **32'** in the molded carrier for the resistor contactor must be deeper than that of the preferred embodiment of the invention, thus increasing the axial dimension of the resistor housing as well as the overall length of the unit. Also, in this embodiment of the invention the driver for the switch is a simple U-shaped stamping having opposite parallel arms slidably but non-rotatably received in a non-circular hole **71** in the rear wall **29'** of the resistor housing. However, as in the other embodiment of the invention, the forward limit of spring produced motion of the driver **61'** is limited by the engagement of means on the driver arms with the rear face of the wall **29** to preclude the application of objectionable increased spring pressure upon the contactor assembly of the variable resistor. In this case, however, the means for limiting such forward motion of the driver comprises stop lugs **72** formed on the rear extremities of its arms, and overlying portions of the rear wall **29'** of the resistor housing adjacent to the edge of the hole **71** therein.

From the foregoing description it will be readily apparent to those skilled in this art that this invention provides a combination variable resistor and electric switch which has the desirable attribute of enabling actuation of the switch without effecting any change in the adjustment of the variable resistor, and in addition provides a control of this type which is exceptionally compact and small in overall size.

What we claim as our invention is:

1. A combination variable resistor and electric switch wherein the variable resistor has a housing including front and rear walls, and contains a rotary contact carrier adjacent to the rear wall of the housing, and wherein the switch is mounted on the back of the resistor housing and has a rotary contactor and an axially movable non-rotatable driver which is yieldingly biased forwardly, characterized by: the provision of a rotatable elongated switch actuator for translating rearward axial motion of the driver into rotary motion of the contactor; the fact that the contact carrier of the resistor has a well therein opening rearwardly to the interior of the switch housing through a hole in the rear wall of the resistor housing, and in which well a substantial portion of the switch driver is received; by the provision of a control shaft for the combination variable resistor and switch rotatably and axially slidably carried by the front wall of the resistor housing, the inner end portion of said shaft having a slidably splined driving connection with the contact carrier of the resistor and projecting rearwardly through the carrier to have its rear extremity contiguous to the switch driver so as to transmit rearward switch operating motion to the driver as a consequence of depression of

the shaft; and by the provision of cooperating means on the switch and the resistor supporting the switch actuator for rotation coaxially of the control shaft.

2. A combination variable resistor and switch wherein the variable resistor has a housing including front and rear walls and a rotary contactor within the housing driven by a carrier bearing against and receiving end thrust support from the rear wall of the housing, and wherein the switch is mounted upon the back of the rear wall of the resistor housing and has a rotary contactor actuated by an axially movable but non-rotatable switch driver, and a motion translating connection between the switch driver and the rotary switch contactor translates successive axial pushes on the switch driver into switch opening and closing rotation of the rotary switch contactor, said combination resistor and switch being characterized by: the fact that the axially movable switch driver enters the resistor housing through an opening in the rear wall thereof; the fact that the carrier for the rotary contactor of the variable resistor has a well in its rear to accommodate a substantial portion of the switch driver; the provision of a control shaft for the combination resistor and switch slidably and rotatably passing through the front wall of the resistor housing and having a slidably splined driving connection with the carrier of the resistor and engageable endwise against the axially movable switch driver to impart the axial motion thereto necessary to effect the aforesaid switch opening and closing rotation of the switch contactor with successive pushes upon the shaft, said control shaft having a bore therein opening to its rear; and the fact that said motion translating connection between the switch driver and contactor comprises an elongated switch actuator having its rear portion rotatably supported by the switch housing and its forward end portion projecting a distance into the resistor housing and rotatably received in said bore in the control shaft, whereby the switch actuator is conjointly supported by the switch and the resistor.

3. A combination variable resistor and electric switch having housing means including front and rear walls and a common intermediate wall spaced from the front and rear walls and defining a forward compartment for the variable resistor and a rear compartment for the switch, and wherein the variable resistor includes a rotary contact carrier in said forward compartment, adjacent to said intermediate wall, and the switch includes a rotary contactor adapted to be operated by rearward axial motion of a non-rotatable driver which is yieldingly biased forwardly, characterized by: the fact that the contact carrier of the resistor has a well in its central portion opening rearwardly to the interior of the switch compartment through a central hole in said intermediate wall and into which well a main portion of the switch driver normally projects; the provision of a control shaft for the combination variable resistor and switch rotatably and axially slidably carried by the front wall of the housing coaxially of said well, said shaft passing rearwardly through the contact carrier and terminating directly ahead of the main portion of the driver, in the bottom portion of the well in the contact carrier, and the inner end portion of the shaft having a slidably splined driving connection with the contact carrier whereby depression of the shaft produces rearward switch operating motion of the driver without changing the angular position of adjustment of the contact carrier of the resistor, the inner end portion of the shaft having a bore therein; by the provision of means on the driver, rearwardly of the inner end of the operating shaft, interengaged with fixed portions on the housing means, to restrain the switch driver against rotation; and by the provision of an elongated rotatable switch actuator for translating rearward axial motion of the driver into rotation of the rotary switch contactor, a substantial length of said switch actuator at the forward end portion thereof being received in the bore of the control shaft and guidingly supported thereby for rotation on the control shaft axis.

4. The combination variable resistor and electric switch set forth in claim 3, further characterized by the provision of a shoulder on the rear extremity of the operating shaft engageable with the bottom of the well in the contact carrier of the resistor to limit forward axial motion of the operating shaft.

5. The combination variable resistor and electric switch set forth in claim 4, further characterized by the provision of shoulders on the switch driver normally held engaged wtih the rear of said intermediate wall to define the forward limit of axial motion of the driver under the bias acting thereon; and by the fact that the rear extremity of the operating shaft is spaced slightly from the main portion of the driver, so as to prevent the forwardly biased driver from applying force onto the contact carrier of the resistor through the shouldered rear end of the operating shaft.

6. The combination variable resistor and switch set forth in claim 5, wherein said shoulders on the switch driver are provided by opposite arms on the driver, offset rearwardly from the main portion of the driver and overlying said intermediate wall of the housing means outwardly of the central hole therein; and wherein said arms have outer end portions thereof slidingly engaged in axial grooves in side wall portions of the switch compartment to preclude rotation of the driver.

7. The combination variable resistor and electric switch set forth in claim 3, wherein the driver is a U-shaped sheet metal stamping having a flat bight portion opposing the rear end of the operating shaft in thrust receiving relationship thereto, and having flat parallel arms projecting rearwardly of said well through the central hole in said intermediate wall, said hole being non-circular and providing guide edges engaged by the arms of the driver to constrain the driver to axial motion in the housing means, and wherein said arms are provided with shoulders on their rear extremities normally held engaged with the rear surface of said intermediate wall by the biasing force on the driver to limit forward axial motion of the driver.

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