May 2, 1950 D. R. DE BOISBLANC 2,506,491

VOLUME CONTROL

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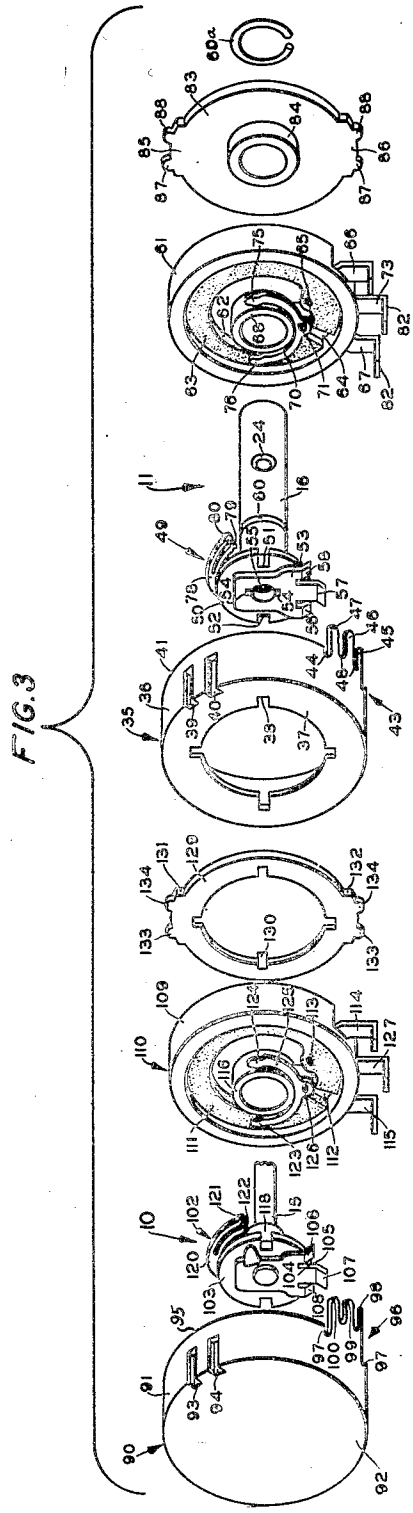


FIG. 3

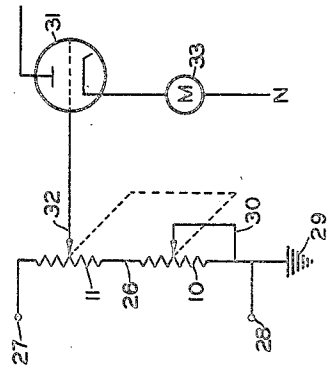


FIG. 4

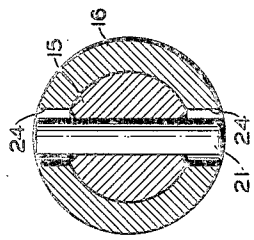


FIG. 2

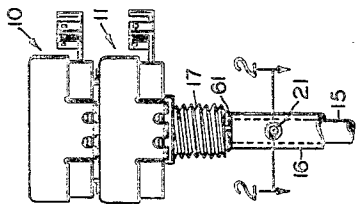


FIG. 1

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VOLUME CONTROL

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4 Claims. (Cl. 201—48)

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This invention relates to a dual control unit embodying a novel shaft construction. In another aspect, it relates to a ganged resistance unit embodying a coarse and fine resistance adjustment.

In many electrical devices, it is desirable to provide a resistance or other control unit to which both a coarse and fine resistance adjustment may be made. This has customarily been accomplished by using a dual resistance unit having two control knobs for adjusting the respective control shafts, or alternatively, having one control knob for operating both shafts. In the latter case, the single control knob turns both shafts to obtain a coarse adjustment. In order to obtain a fine adjustment, the knob is either pulled out or pushed in, thereby actuating a clutch which disconnects one of the shafts from the knob.

In many types of electrical apparatus, and particularly in detonation meters, it is very desirable that one control knob be provided but that no independent adjustment be necessary to transfer the control from a coarse adjustment to a fine adjustment. In such apparatus, the use of two knobs is very confusing to the operator who is usually skilled in testing internal combustion engines but not in the operation of electrical apparatus. For the same reason, the necessity of pulling out or pushing in the control knob to obtain a fine adjustment is also undesirable in electrical apparatus such as detonation meters.

It is an object of this invention to provide a dual resistance unit in which both coarse and fine adjustments may be made without longitudinal displacement of the control knob.

It is a further object to provide a fine adjustment for a rheostat, potentiometer, or other electrical resistance unit, which operates automatically without any conscious effort on the part of the operator. Upon overshooting the desired adjustment in either direction the mere reversal of direction of the knob automatically changes the device from coarse adjustment to fine adjustment.

It is a further object of this invention to provide such a resistance unit which is simple in construction, rugged, durable, and reliable in operation.

Various other objects, advantages and features of the invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

Figure 1 is an elevational view of the improved dual resistance unit;

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Figure 2 is a sectional view taken along the line 2—2 of Figure 1;

Figure 3 is a view of the control with the parts in disassembled relation; and

Figure 4 is a schematic circuit diagram illustrating a suitable connection of my dual resistance unit.

Referring now to the drawings in detail, and particularly to Figure 1, I have illustrated a dual control unit comprising two variable resistors 10 and 11 which are connected together in any suitable manner. The resistance units 10 and 11 have concentric control shafts 15 and 16, respectively, which protrude from a bushing 17 forming a part of the dual resistance unit. The bushing may be provided with the usual lock nuts and washer for attaching the resistance units to a chassis or other support.

In accordance with my invention, a lost motion driving connection is provided between the inner control shaft 15 and the outer control shaft 16 whereby both shafts are rotatable as a unit for making coarse adjustments of resistance and one of said shafts is rotatable independently to a limited extent for making fine adjustments of resistance. In this connection, it will be understood that the resistance unit associated with the independently rotatable shaft has a substantially lower ohmic value than the other resistance unit.

In the particular embodiment shown, the lost motion connection includes a driving member or pin 21 firmly secured within a diametrically extending passage or hole drilled through the inner shaft 15. The end portions of the pin are received within openings 24 in the outer shaft 16, these openings being of substantially larger size than the pin 21. The openings 24 may be conveniently formed by drilling a circular passage through the outer shaft 16 of larger diameter than the pin 21.

It will be apparent that the inner shaft is rotatable, to a limited extent, independently of the outer shaft, such independent rotation occurring while the pin 21 is positioned within the openings 24. However, when the pin 21 engages the walls defining the openings 24, the shafts are rotatable as a unit and the resistance of both units 10 and 11 is simultaneously varied. Assuming that the resistance unit controlled by shaft 15 is of substantially lower ohmic value than the resistance unit controlled by shaft 16, and assuming that the resistance units are interconnected, it will be apparent that small angular movements of the shaft 15 will produce fine adjustments in resistance through rotation of shaft 15 independently

of shaft 16. Larger angular movements of shaft 15 causes the pin 21 to engage the walls of the openings 24, thereby adjusting both resistances simultaneously with the result that a coarse adjustment in resistance is obtained. It will be noted that the novel lost motion connection obviates the necessity for longitudinal movement of the knob in order to obtain a fine adjustment.

A suitable circuit for interconnecting the resistance units is shown in Figure 4 wherein the resistance units 10 and 11 are interconnected by a lead 26 and the terminals of the dual resistance unit thus formed are connected to input terminals 27 and 28. The terminal 28 is grounded at 29 and the movable arm of resistance unit 10 is connected to ground by a wire 30. The movable arm of the unit 11 is connected to the control grid of a tube 31 by a lead 32, the anode and cathode of the tube being connected in a suitable amplifier circuit, not shown, and the cathode having a meter 33 connected in its circuit. In this figure, resistance 10 is very small as compared to resistance 11. Accordingly, simultaneous operation of the resistances produces a coarse adjustment of the input resistance of tube 31 while independent operation of resistance unit 10 produces a fine adjustment of the input resistance, both adjustments being obtainable without the necessity of moving one of the shafts axially in order to provide a fine adjustment. It will be noted that, when the shaft is rotated in one direction to a sufficient extent as to adjust both resistance units simultaneously, rotation of the shaft in the opposite direction automatically brings the fine adjustment into play to the extent of the lost motion between the shafts.

It will be apparent that a suitable control knob may be secured to the outer shaft 16 for varying the resistance of the units 10, 11 in the manner already described. Alternatively, the inner shaft 15 may be extended beyond the outer shaft and the control knob attached to the shaft 15. It will also be apparent that the lost motion connection may be provided by fixing the driving member to outer shaft 16 and providing the lost motion in the connection between the driving member and inner shaft 15. Finally, I do not wish the invention to be limited to the use of a control knob for varying the resistance of the units as other devices such as universal joints, gears, and the like may be used to rotate the control shafts.

The detailed construction of the dual resistance unit is shown by Figure 3, which is a view of a particular dual potentiometer with the parts in disassembled relation. From this figure, it will be seen that resistance unit 11 includes a casing 35 having a cylindrical portion 36 and a flanged portion 37 at the rear of the cylindrical portion 36. Four radial slots 38 are spaced about the inner edge of the flanged portion 37 at intervals of 90 degrees and each slot is of generally rectangular shape, extending radially outward from the inner surface of the flanged portion 37. A pair of stop lugs 39, 40 are formed in the cylindrical portion 36, these lugs protruding radially inward and being closely spaced about the circumference of cylindrical portion 36. In an angular direction, the lugs are positioned substantially half way between two of the slots 38. It will be apparent that the stop lugs extend longitudinally of the cylindrical portion 36 from the flanged portion 37 to a position closely spaced to the outer edge 41 of the cylindrical portion 36. The cylindrical portion 36 is also shaped to form two sets of connecting lugs, one of which is

shown at 43. The other set of lugs, not shown, is constructed in the same fashion as set 43 and is located diametrically opposite the set 43 on the cylindrical portion 36. The lugs 43 are formed integrally with cylindrical portion 36 and, in striking out the lugs, a small slot 44 is formed at each end of the set of lugs. Each set comprises three lugs 45, 46 and 47 which are of generally rectangular shape, although the corners may be slightly rounded, if desired. The central lug 46 is preferably slightly longer and wider than the outer lugs 45 and 47, and the metal surfaces 48 between each adjacent pair of lugs may be slightly rounded, if desired.

The outer shaft 16, which is hollow and adapted to receive the inner shaft 15, carries a rotor generally indicated by reference numeral 49, this rotor being adapted to fit within the casing 35. A disc 50 of insulating material is secured to the inner end of the shaft 16 in any suitable manner. The disc is preferably made of insulating material such as Bakelite but other types of insulating materials may be used if desired, as those skilled in the art will understand. In the preferred embodiment, a metal contactor is held in abutting relation on the inner side of the disc 50 by lugs 51 which fit into two diametrically opposed slots 52 on the rotor. This contactor serves as a contact plate to connect the rotor of the resistance unit to a stationary contact terminal. A metal plate 53, preferably of copper, is held against the inner surface of the insulating disc 50 by a pair of diametrically opposed lugs 54 which are struck from shaft 16 and are bent over the plate 53, thereby holding disc 50 against the end of the shaft. It will be noted that the plate 53 has an opening 55 formed therein of sufficient size as to receive the shaft 15. The plate 53 is of generally rectangular shape and has, at its lower end, three lugs 56, 57 and 58, the extreme ends of the lugs 56, 58 being inwardly bent and the extreme end of lug 57, which is wider and longer than the lugs 56 and 58, being bent in the opposite direction. The space between the bent end portions of lugs 56, 58 is occupied by an insulating member integrally formed with and protruding from the circumference of the insulating disc 50. When the rotor is positioned within the casing 35, the outer end of lug 57 is engageable with the stops 39 and 40 to limit the rotary movement of shaft 16.

Spaced from the rotor 49 on shaft 16 is a circumferential groove 60, this groove being adapted to receive a split ring 60a to hold the parts of volume control 11 in assembled relation. When the control is assembled, one or more of the lugs 45, 46, 47 is bent over the stator to be later described, to hold the casing and stator. It will be noted that shaft 16 is also drilled to form the openings 24 previously referred to in the description of Figure 2.

The stator of resistance unit 11 includes a molded base 61 of insulating material which is of generally cylindrical configuration and which has an integral flange 62 formed thereon, the surface 63 of this flange being coated with a suitable resistance compound, such as a suspension of carbon particles, to form a resistance element. The flange 62 is split, as indicated at 64, to prevent short circuiting of the two ends of the resistance element and one end of this element is connected by a spun-over conductor portion 65 to a terminal 66. This terminal extends through a suitable opening in the base 61 and has its inner end connected through the member 65 to the car-

bon coating forming the resistance element 63. In similar fashion, a terminal 67 is secured to the other end of the resistance element 63 through a spun-over contact, not shown.

The base 61 is also molded to form a central cylindrical bushing 68 for accommodating the shaft 16 and this bushing is adapted to abut this metal contactor positioned against the outer surface of insulating disc 50. A bifurcated contact arm 70 is secured by a rivet 71 to the base 61 and this rivet provides an electrical contact between the contact arm 70 and a terminal 73 which extends through a suitable opening in the base, and is secured thereto in any suitable manner. The contact arm 70 is formed from resilient spring material and its arms are disposed in encircling relation about the inner cylindrical bushing 68. Dimples 75, 76 are formed in the respective ends of bifurcated contact arm 70 and these dimples form contact portions which are engageable with the metal contactor integrally formed with the lugs 51 and 52 on the outer surface of insulating disc 50. This contactor also has a bifurcated contact arm 78 integrally formed therewith and the outer ends of the forks of contact arm 78 are provided with dimples 79 and 80 which are adapted for resilient engagement with the resistance element 63. Accordingly, it will be apparent that the contact arm 78 forms the movable arm of a potentiometer and that this arm is connected with terminal 73 through bifurcated contact arm 78, the metal contactor integrally formed therewith, bifurcated contact arm 70, and rivet 71. Each of the terminals 66, 67 and 73 has a bent portion 82 at right angles to the main part of the contact arm. Preferably and advantageously, this bent portion has a perforation formed therein to which a wire may be attached and it may also be provided with opposed slots, not shown, to facilitate soldering of a lead thereto.

Cooperating with the stator 61 is a metal disc 83 which has a central opening defined by a bushing 84, this opening being of sufficient size as to readily accommodate shaft 16. The plate 83 is provided with diametrically opposed sector members 85, 86 protruding from the circumferential region thereof and each of these members has a pair of lugs 87, 88 formed thereon. The plate 83 may be secured to base 61 by bending the lugs 87, 88 over the base or, alternatively, the base may be provided with suitable projections, not shown, for engaging the members 85 and 86. The bushing 17, Figure 1, may be secured to plate 83 in any suitable manner and the shaft may be held in proper relation thereto by the split clinch ring 60*a*.

It will be apparent that, when these parts are assembled, a potentiometer is formed, the ends of the resistance element being connected to terminals 66, 67 and the movable contact being connected to terminals 73. It will also be apparent that the position of the movable contact may be varied by rotation of the shaft 16. Further, all the parts are securely held in assembled relation and convenient stop means is provided for preventing rotation of the shaft by greater than a predetermined angular movement.

The resistance unit 10 includes a casing 90 having a cylindrical portion 91 and a disc portion 92 at the rear of the cylindrical portion 91. A pair of stop lugs 93, 94 are formed in the cylindrical portion 91, these lugs protruding inwardly and being closely spaced about the circumference of cylindrical portion 91. It will

be apparent that the stop lugs extend longitudinally of the cylindrical portion 91 from the disc 92 to a position closely spaced to the outer edge 95 of cylindrical portion 91. The cylindrical portion 91 is also shaped to form two sets of connecting lugs, one of which is shown at 96. The other set of lugs, not shown, is constructed in the same fashion as set 96 and is located diametrically opposite the set 96 on the cylindrical portion 91. The lugs 96 are integral with cylindrical portion 91 and, in striking out the lugs, a small slot 97 is formed at each end of the set 96. Each set comprises three lugs 98, 99, 100 which are of generally rectangular shape, although the corners may be slightly rounded, if desired. The central lug 99 is preferably slightly longer and wider than the other lugs 98 and 100, and the metal surfaces between each adjacent pair of lugs may be slightly rounded, if desired.

The inner shaft 15, which is adapted to fit within the tubular outer shaft 16, carries a rotor generally indicated by reference numeral 102, this rotor being adapted to fit within the casing 90. A disc 103 of insulating material, which is similar to the disc 50, is secured to the inner end of shaft 15 by lugs 104, these lugs being integral with the shaft and being bent over a metal plate 105, preferably formed from copper. The plate 105 is of generally square configuration and it has, at its lower end, three lugs 106, 107 and 108. Lugs 106 and 108 are bent outwardly toward the disc 103 and they abut a sector-like projection integrally formed with insulating disc 103. The lug 107 is somewhat longer and wider than lugs 106 and 108, this lug being bent in opposite direction, as compared to lugs 106 and 108. Accordingly, lug 107 is adapted to engage stop lugs 93 and 94 when the rotor is positioned within casing 90, thereby to limit the angular movement of shaft 15. The lugs 98, 99 and 100 are adapted to be bent over a cylindrical portion 109 of a molded stator member 110 to hold the stator and casing 90 in assembled relation.

The stator 110 has an integral flange 111, the surface of which is coated with a suitable resistance compound, such as a suspension of carbon particles, to form a resistance element. Preferably and advantageously, the ohmic value of resistance element 111 is substantially smaller than the ohmic value of the resistance element 63 of unit 11. In a preferred embodiment, resistance element 111 may have a value of 75,000 ohms while resistance element 63 may have a value of 1 megohm. The flange upon which resistance element 111 is formed is split at 112 to prevent short circuiting of the adjacent ends of the resistance element, and one end of the element is connected by a rivet 113 to a terminal 114 which extends through a suitable opening formed in the stator 110. In similar fashion, the other end of resistance element 111 is connected to a terminal 115 through a conductive rivet, not shown.

A central bushing 116 is integrally formed with the stator 110, this bushing being of sufficient size to accommodate shaft 15 and a sleeve 118 mounted thereon. The sleeve 118 is locked in position upon the shaft by a suitable clinch ring, not shown, and its function is to hold the parts of the rotor assembly in proper assembled relation. A bifurcated contact arm 120 is carried by the outer surface of insulating disc 103 and the outer end of the forks of this contact arm are provided with dimples 121, 122 which are adapted to rub against resistance element 111 and form

a slidable electrical contact therewith. The bifurcated arm or contactor 120 is secured to disc 103 in any suitable manner and it has a flat conductive portion, not shown, which abuts disc 103 and is adapted to be continuously engaged by dimples 123, 124 formed on a bifurcated contact arm 125. The bifurcated arms of member 125 encircle the bushing 116 and are formed of resilient material so as to continuously engage the previously described contact surface integrally formed with contactor 120. The member 125 is secured to stator 110 by a rivet 126 which is in electrical communication with a terminal 127 extending through an opening in the stator 110 and secured thereto in any suitable manner. It will be apparent that terminal 127 is in electrical communication with contactor 120 through rivet 126, bifurcated contact arm 125 and the contact surface integrally formed with contactor 120 and carried by disc 103.

A support and clamping ring 129 is mounted between stator 110 and casing 35. This ring has a plurality of connecting lugs struck out therefrom, one of which is indicated at 130. The lugs 130 are spaced about the inner edge of ring 129 at intervals of 90 degrees and they are adapted to fit within the radial slots 38 formed in the flanged portion 37 of casing 35, thereby to hold the ring and casing in assembled relation. The ring 129 is also provided with integral shoulders 131 and 132 which protrude from the periphery of the ring and have generally sector-like configuration. A pair of lugs 133, 134 are formed on each of the projections 131, 132 and these lugs are adapted to be bent into contact with the stator 109 to hold the ring 129 and stator in assembled relation. Alternatively, one or more of the lugs 98, 99 and 100 may be bent over the projections 131 and 132 to hold the ring 129 and casing 90 in assembled relation.

It will be apparent that, when these parts are assembled, a potentiometer is formed, the ends of resistance element 111 being connected to the respective terminals 114, 115 and the movable contact being connected to terminal 127. Preferably and advantageously, each of the terminals 114, 115 and 127 has a bent portion perpendicular to the main part of the terminal. This bent portion may have a perforation formed therein to which a conductor may be attached, and it may be provided with opposed slots, not shown, to facilitate soldering of a lead thereto. It will be apparent that the position of the movable contact 102 may be varied by rotation of shaft 15, thereby changing the resistance ratio between the wire connected to lead 127 and the wires connected to the respective terminals 114 and 115. Further, all the parts are securely held in assembled relation and convenient stop means is provided for preventing rotation of the shaft by greater than a predetermined angular movement.

When the parts of the dual volume control are assembled in the manner described, and a control knob is attached to shaft 15, for example, small angular movements of shaft 15 will produce fine adjustments in resistance through rotation of shaft 15 independently of shaft 16. Larger angular movements of shaft 15 cause the pin 21, Figures 1 and 2, to engage the walls of the openings 24, thereby adjusting both resistances simultaneously to effect a coarse adjustment. It will be noted that, when the shaft is rotated in one direction to a sufficient extent as to adjust both resistance units simultaneously, rotation of the shaft in the opposite direction automatically brings the fine adjustment into play to the extent of the lost motion between the shafts.

While the invention has been described in connection with a present, preferred embodiment thereof, it is to be understood that this description is illustrative only and is not intended to limit the invention, the scope of which is defined by the appended claims.

Having described my invention, I claim:

1. A dual resistance unit comprising, in combination, first and second variable resistance units, said first unit including a tubular control shaft, a rotor carried by said shaft, a contact surface and a contact element carried by said rotor, said surface being electrically connected to said element, a stator having an opening therein for receiving said tubular shaft, an arcuate resistance element carried by said stator for engagement by said contact element, a contactor carried by said stator and engageable with said contact surface, three terminals carried by said stator connected, respectively, to said contactor and the respective ends of said resistance element, said second unit including a shaft of smaller diameter than said tubular shaft and mounted concentrically therewith, a second rotor carried by said second shaft, a second contact surface and a second contact element carried by said second rotor, said surface being electrically connected to said element, a second stator having an opening therein for receiving said second shaft, a second resistance element carried by the second stator for engagement by the second contact element, one of said resistance elements being of substantially higher ohmic value than the other resistance element, a contactor carried by the second stator for engagement with said second contact surface, three terminals carried by said second stator and connected, respectively, to said second contactor and the respective ends of said second resistance element, and a lost motion connection between said shafts including a driving member fixed to one of said shafts, the other shaft being shaped to form an opening for receiving said driving member, said opening being substantially larger than said member whereby said first shaft is independently rotatable to a limited extent when said member is positioned within said opening and said shafts are rotatable as a unit when said member engages the walls defining said opening.

2. A dual resistance unit comprising, in combination, first and second variable resistance units, said first unit including a tubular control shaft, a rotor carried by said shaft, a contact surface and a contact element carried by said rotor, said surface being electrically connected to said element, a stator having an opening therein for receiving said tubular shaft, an arcuate resistance element carried by said stator for engagement by said contact element, a contactor carried by said stator and engageable with said contact surface, three terminals carried by said stator connected, respectively, to said contactor and the respective ends of said resistance element, said second unit including a shaft of smaller diameter than said tubular shaft and mounted concentrically therewith, a second rotor carried by said second shaft, a second contact surface and a second contact element carried by said second rotor, said surface being electrically connected to said element, a second stator having an opening therein for receiving said second shaft, a second resistance element carried by the second stator for

engagement by the second contact element, one of said resistance elements being of substantially higher ohmic value than the other resistance element, a contactor carried by the second stator for engagement with said second contact surface, three terminals carried by said second stator and connected, respectively, to said second contactor and the respective ends of said second resistance element, and a lost motion connection between said shafts including a driving pin fixed to the inner control shaft and having its ends protruding radially therefrom, the outer shaft having diametrically opposed bores therein of larger diameter than said pin for receiving the protruding ends thereof whereby said inner shaft is independently rotatable to a limited extent when the protruding ends of said pin are positioned within said bores and both of said shafts are rotatable as a unit when said pin engages the walls defining said bores.

3. A dual resistance unit comprising, in combination, first and second variable resistance units, said first unit including a tubular control shaft, a rotor carried by said shaft, a casing including a cylindrical section, a pair of stop lugs struck inwardly from said cylindrical section, a metal plate carried by said rotor, said metal plate having a lug struck therefrom which extends radially of said tubular control shaft and has a bent portion engageable with said stop lugs to limit the angular movement of said tubular control shaft, a contact surface and a contact element carried by said rotor, said surface being electrically connected to said element, a stator having an opening therein for receiving said tubular shaft, an arcuate resistance element carried by saidstator for engagement by said contact element, a contactor carried by said stator and engageable with said contact surface, three terminals carried by said stator connected, respectively, to said contactor and the respective ends of said resistance element, said second unit including a shaft of smaller diameter than said tubular shaft and mounted concentrically therewith, a second rotor carried by said second shaft, a second casing having a cylindrical section, a pair of stop lugs struck inwardly from said second cylindrical section, a metal plate carried by said second motor, said plate having a radially extending lug, the end of said lug being bent so as to be engageable with said stop lugs, thereby to limit the angular movement of said shaft of smaller diameter, a second contact surface and a second contact element carried by said second rotor, said surface being electrically connected to said element, a second stator having an opening therein for receiving said second shaft, a second resistance element carried by the second stator for engagement by the second contact element, one of said resistance elements being of substantially higher ohmic value than the other resistance element, a contactor carried by the second stator for engagement with said second contact surface, three terminals carried by said second stator and connected, respectively, to said second contactor and the respective ends of said second resistance element, and a lost motion connection between said shafts including a driving member fixed to one of said shafts, the other shaft being shaped to form an opening for receiving said driving member, said opening being substantially larger than said member whereby said first shaft is independently rotatable to a limited extent when said member is positioned within said opening and said shafts are rotatable as a unit when said member engages the walls defining said opening.

4. A dual resistance unit comprising, in combination, first and second variable resistance units, said first unit including a tubular control shaft, a rotor carried by said shaft, a casing including a cylindrical section, a pair of stop lugs struck inwardly from said cylindrical section, a metal plate carried by said rotor, said metal plate having a lug struck therefrom which extends radially of said tubular control shaft and has a bent portion engageable with said stop lugs to limit the angular movement of said tubular control shaft, a contact surface and a contact element carried by said rotor, said surface being electrically connected to said element, a stator having an opening therein for receiving said tubular shaft, an arcuate resistance element carried by said stator for engagement by said contact element, a contactor carried by said stator and engageable with said contact surface, three terminals carried by said stator connected, respectively, to said contactor and the respective ends of said resistance element, said second unit including a shaft of smaller diameter than said tubular shaft and mounted concentrically therewith, a second rotor carried by said second shaft, a second casing having a cylindrical section, a pair of stop lugs struck inwardly from said second cylindrical section, a metal plate carried by said second rotor, said plate having a radially extending lug, the end of said lug being bent so as to be engageable with said stop lugs, thereby to limit the angular movement of said shaft of smaller diameter, a second contact surface and a second contact element carried by said second rotor, said surface being electrically connected to said element, a second stator having an opening therein for receiving said second shaft, a second resistance element carried by the second stator for engagement by the second contact element, one of said resistance elements being of substantially higher ohmic value than the other resistance element, a contactor carried by the second stator for engagement with said second contact surface, three terminals carried by said second stator and connected, respectively, to said second contactor and the respective ends of said second resistance element, and a lost motion connection between said shafts including a driving pin fixed to the inner control shaft and having its ends protruding radially therefrom, the outer shaft having diametrically opposed bores therein of larger diameter than said pin for receiving the protruding ends thereof whereby said inner shaft is independently rotatable to a limited extent when the protruding ends of said pin are positioned within said bore and both of said shafts are rotatable as a unit when said pin engages the walls defining said bores.

DESLONDE R. DE BOISBLANC.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,592,193	Farnsworth	July 13, 1926
1,654,867	De Laval	Jan. 3, 1928
2,277,883	Rich	Mar. 31, 1942
2,401,037	Arvin	May 28, 1946

FOREIGN PATENTS

Number	Country	Date
450,238	Germany	Mar. 27, 1926