Feb. 3, 1970 R. J. SEDORY 3,493,697

MINIATURE PLUG-IN CIRCUIT CONTROLLERS

Filed Sept. 3, 1968

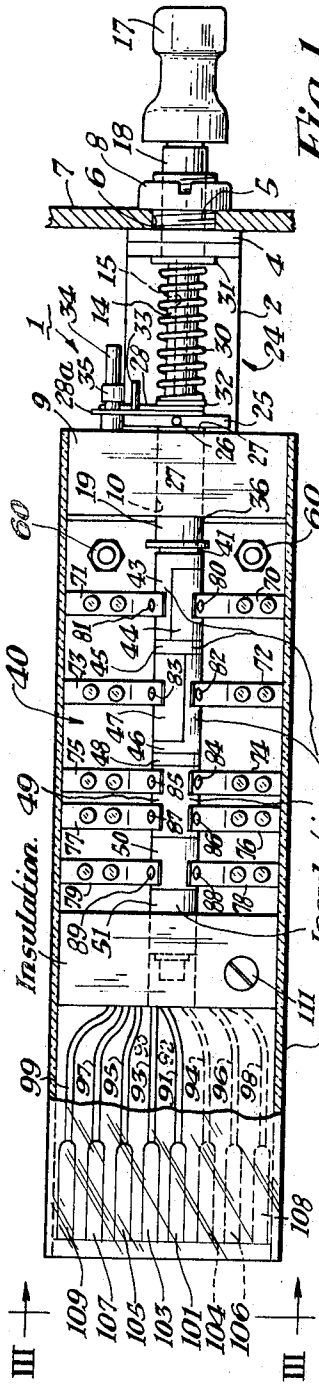


Fig. 1.

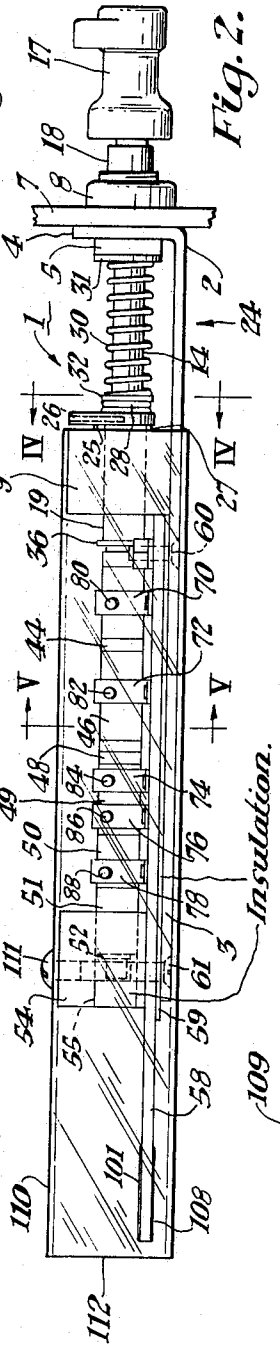


Fig. 2.

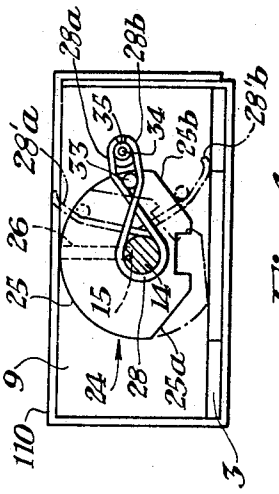


Fig. 4.

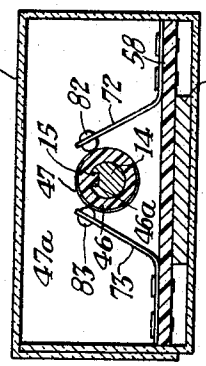


Fig. 5.

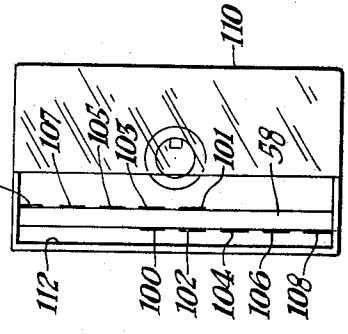


Fig. 3.

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MINIATURE PLUG-IN CIRCUIT CONTROLLERS

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ABSTRACT OF THE DISCLOSURE

This disclosure relates to a push-pull rotary type of circuit controller comprising an L-shaped supporting bracket having a plurality of bearings. A spring biased return-to-neutral operating rod is journalled in the bearings and has an actuating handle for pushing, pulling and rotating the operating rod. A plurality of cylindrical movable contacts are carried by the operating rod and a plurality of stationary spring contacts by a printed circuit board are cooperatively associated with the movable contacts for selectively opening and closing the stationary spring contacts in accordance with the operating of the actuating handle.

My invention relates to miniature plug-in circuit controllers and, more particularly, to push-pull-rotary return-to-neutral electrical circuit controllers which are suitable for selectively controlling the electrical condition of a plurality of external circuits.

In the operation of a railroad, it is common practice to simulate the actual rail routes or trackage on a track model control panel which is located at a central office. Such control panels are generally employed in C.T.C. (centralized traffic control) systems, where the entire railroad operation, namely, the movement of trains is directed by wayside or cab signals in accordance with routes remotely established at the central office. In order to set up the various routes or blocks over or through which any given train is to pass, it has been found highly advantageous to utilize multiple function types of electrical switching devices or circuit controllers for this purpose. That is, since the railway switches which establish the physical course of travel and the indication signals which govern the given route are interrelated, it is desirable to correlate and control these external circuits through suitable circuit controllers which are capable of multiple transfer switching functions. Further, it is of importance to minimize the overall size of the circuit controller so that a multitude of circuit controllers may be suitably mounted on the control panel within easy access of the operator. Additionally, in order to facilitate installation and servicing, it is highly desirable to utilize a plug-in type of terminal arrangement so that such circuit controllers may be readily replaced and installed with less likelihood of erroneous electrical hook up to the various external circuits. In the past, circuit controllers or control switches generally employed cams for operating either stacked contact springs or resilient contact fingers. It will be appreciated that such previous arrangements were not only susceptible to excessive frictional wear, fatigue and contact pitting but also required repeated adjusting for proper electrical contact. In addition to these problems, other shortcomings, such as

excessive contact bounce and arcing, arduous assembling and disassembling, tedious hand-solder wiring and possible heat damage, and unduly number of parts required in prior art types of circuit controllers have resulted in highly complex switch devices which are economically expensive to produce as well as to maintain.

Accordingly, it is an object of my invention to provide a new and improved circuit controller for solving the above-mentioned problems.

Another object of my invention is to provide a unique miniature plug-in type of circuit controller which selectively controls a plurality of external circuits.

Yet another object of my invention is to provide an improved push-pull-rotary type of circuit control employing a printed circuit board for electrically interconnecting a plurality of external circuits with a plurality of transfer switching contacts.

A further object of my invention is to provide a unique circuit controller having a cylindrical type of movable contact assembly cooperatively associated with stationary contact fingers for performing transfer switching functions.

Yet a further object of my invention is to provide a unique push-pull-rotary return-to-neutral circuit controller which has a minimum of wear, fatigue and contact pitting.

Still another object of my invention is to provide a novel circuit controller which employs a printed circuit type of stationary contact assembly and a cylindrical type of movable contact assembly for establishing and interrupting various electrical circuits.

Still a further object of my invention is to provide a new and improved plug-in type of circuit controller having a self-indexing cylindrical movable contact assembly which is cooperatively associated with a plurality of stationary spring contacts for performing transfer switching functions.

Still yet another object of my invention is to provide an improved circuit controller which may be pushed, pulled and rotated for controlling a plurality of external circuits and which is spring biased to a normal neutral position by means of a single compression and a single torsion spring.

Still yet a further object of my invention is to provide a new and improved circuit controller which is simple in construction, economical in cost and efficient and reliable in operation.

Generally, my invention relates to a circuit controller comprising an L-shaped supporting bracket having a threaded bushing securely fastened to one leg of the L-shaped bracket and a metallic and nonmetallic bearing block disposed intermediate and at the free end on the other leg of the L-shaped bracket, respectively. An operating rod passes axially through the threaded bushing and the metallic and nonmetallic bearing blocks and includes an actuating handle at one end thereof for permitting ready access for longitudinal and/or rotational manipulation. A return-to-neutral biasing assembly including a compression spring, a torsion spring and a sector return plate surrounds the operating rod and is disposed between the theaded bushing and the metallic bearing block. The sector return plate includes a first axially extending pin while the metallic bearing block includes a second axially extending pin. A low-friction spool is slidably disposed on the second extending pin so that the re-

spective ends of the torsion spring ride on the spool and cooperate with the first axially extending pin for angularly biasing the operating rod to a neutral position. A transfer switching assembly including a plurality of movable and stationary contacts is disposed between the metallic and the nonmetallic bearing blocks. The movable contacts include a plurality of conductive ring and segment elements which are axially disposed in insulative relationship by means of a plurality of insulative sleeves and spacers telescoped over the operating rod. The stationary contacts include a plurality of pairs of conductive spring contact fingers disposed on each side of the operating rod in cooperative association with selected ones of the ring and segment elements. Each of the spring contact fingers is electrically connected to and carried by a printed circuit board which is also securely fastened to the other leg of the L-shaped supporting bracket. The printed circuit board includes terminal portions for connection to external circuits which are complete and interrupted in accordance with longitudinal and rotational manipulation of the actuating handle which causes the opening and closing of the stationary contacts by the movable contacts.

A better understanding of my invention will be had by the reference to the drawings in which like reference characters refer to similar parts throughout the several views in which:

FIG. 1 is a top elevational view of a circuit controller embodying the present invention with a portion of the cover broken away to more clearly illustrate the details thereof.

FIG. 2 is a side elevational view of the circuit controller of FIG. 1.

FIG. 3 is a slightly enlarged rear elevational view of the circuit controller of FIG. 1.

FIG. 4 is a slightly enlarged transverse sectional view taken substantially along the line IV—IV of FIG. 2.

FIG. 5 is a slightly enlarged transverse sectional view taken substantially along the line V—V in FIG. 2.

Referring now to the drawings and more particularly to FIGS. 1 and 2, it will be noted that the circuit controller generally characterized by numeral **1** includes a main L-shaped supporting bracket or frame **2** which effectively carries the remaining elements of the circuit controller. The supporting bracket **2** preferably consists of a flat piece of sheet steel or other suitable material. The frame **2** is prebent or formed to have a long horizontal extending portion or leg **3** and a short vertical extending portion or leg **4**. The vertical leg **4** is provided with a suitable hole which accommodates a threaded flanged bushing **5**. That is, the bushing **5** is axially aligned with the hole in the leg **4** and is fixedly secured to the same by being either welded or soldered thereto. As shown, the flange portion of the bushing **5** is disposed adjacent the inner surface of the vertical leg portion while the threaded portion extends forwardly with clearance through a hole, or circular aperture **6** formed in a mounting panel **7**. A mounting nut **8** is screwed onto the threaded portion of the bushing **5** and engages the front wall of the mounting panel **7** so that the major portion of the circuit controller is effectively disposed behind the mounting panel **7**.

It will be seen that the horizontal leg **3** of the supporting bracket **2** is provided with an intermediate metallic bearing block **9** which is suitably secured to the horizontal leg portion **3**, such as by welding or soldering. As shown, an operating rod or shaft **14** passes completely through the threaded bushing **5** with a portion extending from the front side of the mounting panel **7**. The operating rod **14** also passes through a circular opening **10** of the intermediate bearing block **9** which is in axial alignment with bushing **5**. An actuating knob or handle **17** is securely fastened to the portion of the operating rod **14** which extends beyond the front wall of the panel **7**, such as, by a set screw or other suitable fastening means. It will be noted that the operating rod **14** is provided with

a rectangular slot **15** which extends axially along the entire length of the rod **14**, the purpose of which will be described hereinafter. In order to minimize frictional wear and alleviate the need of a lubricating vehicle, a polished metallic sleeve **18** is preferably slidably disposed within the threaded bushing **5** and projects slightly beyond the front surface of the bushing **5**. Similarly, a polished chrome sleeve **19** is disposed around the operating rod **14** and cooperates with the central opening **10** of bearing block **9** to provide a low friction type of bearing surface therewith.

As shown in FIGS. 1, 2 and 4, a return-to-neutral spring biasing assembly **24** is shown positioned between the threaded bushing **5** and the metallic bearing block **9**. The spring biasing assembly includes a sector return plate **25**, a torsion spring **28**, and a helical compression spring **30**.

The sector return plate **25** is disposed adjacent the metallic bearing block **9** and is restricted from rotating or moving angularly with respect to rod **14** by means of a cylindrical pin **26** which is pressed into a suitable through hole (not characterized) in the return plate **25** and communicates with the axially extending slot **15** of the operating rod **14**, as shown in FIG. 4. It will be appreciated that such an arrangement prevents angular displacement but permits axial displacement to occur between the plate **25** and rod **14**. Preferably, a suitable washer **27** of low friction bearing material is disposed between the sector return plate **25** and the metallic bearing block **9** in order to reduce the frictional wear and drag between the adjacent surfaces of the sector plate **25** and metallic bearing block **9**.

The helical compression spring **30** surrounds operating rod **14** and is initially placed under compression between a first metallic washer **31** which is disposed adjacent the inner side of threaded bushing **5** and a second metallic washer **32** which engages the adjacent side of the torsion spring **28**. Accordingly, it will be appreciated that the compression spring **30** will cause the operating rod to return to its neutral position after the handle **17** is either pushed or pulled and thereafter released. Further, the longitudinal pushing motion of the operating rod **14** is limited by engagement of the adjacent inner surface of the handle **17** with the adjacent outer surface of the threaded bushing **5**. The longitudinal outward movement of the operating rod is limited by a third washer **36** which surrounds rod **14** and engages the rear surface of the metallic bearing block **9** when the handle **17** is pulled.

As shown, the convolute portion of the torsion spring **28** surrounds the operating shaft **14** and is disposed between the confronting face of the sector return plate **25** and the adjacent surface of the second washer **32**. The convolution of the torsion spring **28** terminates in a pair of radially extending crossed-arm portions **28***a* and **28***b* which are turned-in at their outer extremities. The sector return plate **28** is provided with a first axially extending pin **33** which cooperates with the radially extending portions **28***a* and **28***b* of the torsion spring **28**. That is, in viewing FIG. 4, it will be noted that the pin **33** cooperates with two arms intermediately beyond the crossing point of the radially extending portions **28***a* and **28***b*. The metallic bearing block **9** is provided with a second axially extending pin **34** upon which a spool **35** of suitable low friction material, such as, nylon or "Teflon" is slidably disposed thereon. The intermediate reduced portion of spool **35** is engaged by the outer turned-in extremities of the radially extending portions **28***a* and **28***b* of the torsion spring **28**. Accordingly, the sector return plate **25** and the operating rod are constantly urged to assume a normally neutral position as shown by the solid lines in FIG. 4. Further, it will be noted that the sector plate **25** is provided with a pair of flat surfaces **25***a* and **25***b* as shown in FIG. 4 which cooperates with the upper surface of the horizontal leg **3** of the supporting bracket **2** for limiting the amount of angular rotation of the operating rod **14**.

For example, in viewing FIG. 4, it will be noted that the operating rod **14** is limited in the counterclockwise direction by the flat surface **25***a* engaging the upper surface of the horizontal leg portion **3** and is limited in the clockwise direction by the flat surface **25***b* engaging the upper surface of the horizontal leg **3**.

Accordingly, both the rotational and longitudinal movement of the handle **17** and, in turn, the operating rod **14** is restricted to certain limits so that excessive stresses and strains cannot be exerted on either of the biasing springs.

The electrical switching assembly generally characterized by the numeral **40** is composed of a plurality of movable and fixed or stationary contacts. The movable contacts take the form of circular segment and ring conductive elements which are disposed on the remote end of the operating rod **14** in insulative relationship thereto. As shown, a snap type of retainer **41** is located in a suitable annular slot (not characterized) in the operating rod **14** to maintain the washer **36** and metallic sleeve **19** in their proper relationship on the operating rod. Then, a first tubular member **43** of suitable insulating material is telescoped over the operating rod **14** and positioned adjacent the retainer ring **41**. A circular conductive segment contact element **44** is snapped into a suitable arcuate cutout portion formed in the insulative sleeve **43**. Next a spacer sleeve **45** is telescoped over the operating rod **14** adjacent the other side of the insulative contact sleeve **43**. A second insulative sleeve **46** and circular conductive segment contact element **47** are disposed adjacent to the spacer sleeve **45**. Both the insulative sleeves **43** and **46** as well as the circular conductive segments **44** and **47** are identical in construction and may be interchangeable by simply turning them end for end. In viewing FIG. 5, it will be noted that the circular segment contact **47** as well as contact element **44** makes an arc which is greater than 180 degrees so that when they are snapped into the appropriate recesses in the insulative sleeves a compressive force retains them therein. It will be appreciated that the segment contacts **44** and **47** may be assembled either beforehand or snapped into place after the sleeves are placed on the operating rod. Further, in viewing FIG. 5, it will be noted that the insulative sleeve **46** is provided with an indexing key **46***a* which cooperates with the axial slot **15** of the operating rod **14** so that both of the sleeves **43** and **46** are automatically positioned with respect to the operating rod **14**. Next a narrow conductive ring contact element **48** and an insulative sleeve **49** are telescoped over the operating rod **14** and disposed adjacent the insulative sleeve **46**. The insulative sleeve **49** is suitably provided with a diametrically reduced end portion for accomodating the ring contact element **48**. Finally, a wide conductive ring contact element **50** and insulative cylindrical sleeve **51** are telescoped over the operating rod **14** and disposed adjacent the insulative sleeve **49**. The wide conductive ring contact element **50** is also placed on the diametrically reduced end portion formed on the insulative sleeve **51**. In viewing FIGS. 2 and 5, it will be noted that the arcuate cutout portions and the diametrically reduced portions formed in the insulative sleeve members **43**, **46** and **49**, **51** preferably have a depth which is equal to the thickness of the conductive elements so that the circumferential exterior surface of the movable contact assembly is substantially smooth and free of irregularities. Finally, a snap-on retainer ring **52** is pushed over and is snugly fitted within a suitable annular recess formed on the end of the operating rod **14** for retaining and securely holding the movable contact assembly in proper relationship thereto.

As shown, a nonmetallic bearing block **54** is disposed in cooperative relationship with the rearward end of the operating rod **14** and includes a central circular opening **55** which accommodates the end of the operating rod **14** and the insulative sleeve **51**. The nonmetallic bearing block **54** is preferably constructed of a suitable low friction type of insulating material, such as, nylon, thereby providing electrical isolation as well as a low frictional mechanical bearing arrangement.

The stationary contact assembly includes a plurality of spring contact fingers which are supported and carried by a printed circuit board **58** which is generally rectangular in shape. As shown, a sheet of suitable insulating material **59** is disposed between the printed circuit board **58** and the horizontal leg **3** for electrically insulating the printed circuit conductors from the metallic support member **2**. The forward end of the printed circuit board **58** and insulating sheet **59** are securely held to the horizontal leg **3** by means of screws and bolts **60**. The rearward end of the horizontal leg **3** is provided with a pair of countersunk holes for accommodating suitable screws, only one being shown at **61** in FIG. 2, which pass through holes in the insulating sheet **59** and printed circuit board **58** and threadedly engage the nonmetallic bearing block **54** for holding the elements in proper relationship with each other. As shown, resilient spring contact fingers which are preferably constructed of phosphorus bronze material are arranged in bridging pairs. Each of the contact fingers is secured to the upper surface of the printed circuit board **58** by suitable fastening means, such as by rivets. A first pair of spring contact fingers **70** and **71** is disposed in cooperative association with the movable contact assembly. The fingers **70** and **71** preferably include contact points or tips **80** and **81** of improved conductive material, such as silver, and are arranged in communication with the conductive segment contact element **44** and the insulative sleeve **43**, respectively, when the circuit controller is in its normal neutral position. Similarly, a second pair of spring contact fingers **72** and **73** is carried by the printed circuit board but are disposed axially of the first pair of fingers so that the associated contact points **82** and **83** normally engage the insulative sleeve **46** and the conductive contact segment element **47** respectively. The third pair of spring contact fingers **74** and **75** including a pair of associated contact points **84** and **85** which normally rest on the insulative sleeve **49** is riveted to the printed circuit board **58**. Similarly, a fourth pair of contact spring fingers **76** and **77** is riveted adjacent to the contact fingers **74** and **75**. The contact fingers **76** and **77** also include a pair of associated contact points **86** and **87** which normally remain in contact with the insulative sleeve **49**. Finally, a fifth pair of spring contact fingers **78** and **79** including a pair of associated contact points **88** and **89** which normally engage the conductive ring contact element **50** is riveted to the printed circuit board **58**. Further, it will be noted that the printed circuit board **58** includes a plurality of printed circuit leads or conductors **90** through **99** which terminate in appropriate terminals **100** to **109** at the projecting rearward end thereof. The other ends of the conductive leads **90** through **99** are electrically connected to the respective spring contact fingers **70** through **79** by means of the rivets which securely fasten the contact fingers to the printed circuit board. It will be noted in FIGS. 1, 2 and 3 that the terminal portions and their associated conductive leads are symmetrically disposed on opposite sides of the printed circuit board **58**. That is, the terminal portions **101**, **103**, **105**, **107** and **109** and conductive leads **91**, **93**, **95**, **97** and **99** are disposed on the upper surface of the board **58** while the terminal portions **100**, **102**, **104**, **106** and **108** and the conductive leads **90**, **92**, **94**, **96** and **98** are disposed on the under surface of the board **58** so that a suitably wired female plug-in connector may be attached to the printed circuit board without regard to specific orientation. That is, it is impossible to erroneously interconnect the external circuits with respect to the transfer switching functions since the plug-in connector may be turned end-for-end with no resulting change occurring in the electrical interconnection.

As shown, a transparent plastic cover **110** is telescoped over the switching assembly and printed circuit board for protecting the contacts against damage as well as preventing dust and dirt from entering the contact area. It is preferred that the transparent cover **110** be constructed

with suitable plastic material, such as polycarbonate, which permits readily visual inspection of the electrical contacts during periods of maintenance or servicing. Such a plastic material also possesses the advantage that is self-extinguishing. The plastic cover **110** may be securely held in its appropriate position by means of screw **111** which is threadedly screwed to the nonmetallic bearing block **54**. As shown, the rearward end of the cover **110** is provided with a rectangular opening **112** for accommodating the female plug-in connector which is appropriately connected to the various external circuits to be controlled.

Let us assume that the circuit controller **1** is in the position shown in FIGS. 1 and 2 so that the compression and torsional effects of the spring biasing assembly **24** maintain the circuit controller in its normally neutral position. Under this condition, the electrical switching assembly **40** is arranged to have four normally opened switch contacts and one normally closed switch contact. That is, since the contact tip **81** of the stationary contact finger **71** engages the insulative sleeve **43**, the external circuit common to the terminal portions **101** and **100** is interrupted. Similarly, since the contact tip **82** of the stationary contact finger **72** engages the insulative sleeve **46**, the external circuit common to terminal portions **102** and **103** is interrupted. In viewing FIG. 1, it will be readily noted that both the third and fourth contact switches, namely, contact tips **84** and **85** of stationary contact fingers **74** and **75** as well as contact tips **86** and **87** of stationary contact fingers **76** and **77** engage the insulative sleeve **49** so that both of the external circuits common to terminal portions **104** and **105** as well as terminal portions **106** and **107** are interrupted at this time. However, it will be noted that the external circuit common to terminal portions **108** and **109** is completed from the terminal portion **108**, through lead **98**, through the contact finger **78**, through the contact point **88**, through the conductive ring element **50** through contact point **89**, through contact finger **79**, through lead **99**, to terminal portion **109**.

Let us now assume that it is desirable to establish the external circuit common to the terminal portions **104** and **105**. Under this condition, it is simply necessary to push the handle **17** inwardly to a point where the inner surface of the handle **17** engages the outer extending surface of the threaded bushing **5**. Under this condition, the inward longitudinal movement of the operating rod **14** causes the conductive ring element **48** to be positioned exactly beneath the contact points **84** and **85** so that the spring contact fingers **74** and **75** are bridged by the conductive ring element **48** to complete a circuit through the conductive leads **94** and **95** to the terminal portions **104** and **105** and in turn to the external circuit common therewith. It will be noted that the inward longitudinal movement of the operating rod does not affect the electrical condition of the remaining contact switches and the contact fingers **78** and **79** remain bridged by the ring contact element **50** while the contact fingers **74**, **75** and **72**, **73** as well as **70** and **71** remain opened. Now the actuating handle **17** may either be turned right or turned left or alternatively be released by the operator wherein the compression spring **30** will return the operating rod **14** and in turn the contact assembly to its neutral position as shown in FIGS. 1 and 2. However, the turning of the operating handle **17** in a clockwise direction as viewed in FIG. 4 will cause a similar rotation of the contact assembly so that the contact segment element **44** will bridge the contact points **80** and **81** and thereby establish the external circuit common to terminal portions **100** and **101** through the contact fingers **70** and **71** and conductor leads **90** and **91**. Alternatively, if the handle **17** is rotated in a counterclockwise direction as viewed in FIG. 4, the rotational movement of the operating rod **14** causes the contact segment element **47** to move under the contact point **82** thereby bridging the contact fingers **72** and **73** so that a circuit path is established through conductor leads **92** and **93** and the terminal portions **102** and **103** for completing the external circuit common to the terminal portions **102** and **103**. It will be noted that when the actuating knob **17** is rotated in either direction, either the radial extending portion **28***a* or **28***b* of the torsion spring **28** is displaced by axially extending pin **33**. That is, in viewing FIG. 4, it will be noted that when the actuating handle **17** is rotated in a clockwise direction, the rotational movement of the operating rod **14** causes the sector plate **25** to move in the same direction so that the radial extending portion **28***b* of the torsion spring **28** is moved downwardly as shown by dotted line **28'***b*. Similarly, when the actuating knob **17** is rotated in a counterclockwise direction, the radial extending portion **28***a* of the torsional spring **28** is angularly displaced upwardly as shown by dotted line **28'***a*. It will be noted from viewing FIG. 4 that the angular displacement in either direction is limited by the flat surfaces **25***a* and **25***b* which cooperate with the upper surface of the horizontal leg portion **3** of the supporting bracket **2** for acting as a stop member. Accordingly, when the actuating handle **17** is released, the torsional spring **28** will angularly return while the compression spring **30** axially returns the circuit controller to its intermediate neutral position.

Let us again assume that the circuit controller is in a position as shown in FIGS. 1 and 2 and that the operator pulls the actuating handle **17**. The pulling of the handle **17** causes the operating rod **14** to move outwardly to a point where washer **36** engages the adjacent inner face of the metallic bearing block **9**. That is, since the outer diameter of washer **36** is larger than the circular opening **10** of the metallic bearing block **9**, the operating rod **14** is effectively restricted in the amount of outward longitudinal movement. Since the sector plate **25** is slidably mounted to the operating rod **14** by means of pin **26** and slot **15**, the sector plate **25** undergoes an equal axial displacement which causes the compression spring **30** to become compressed. The torsional spring **28** also moves outwardly with the operating rod **14** and the radial extending portions **28** and **28***b* move with the "Teflon" spool **35** which slides freely with respect to the axially extending pin **34**. It will be noted that the longitudinal displacement of the operating rod causes the conductive ring contact element **50** to interrupt the bridging of contact points **88** and **89** to establish the bridging by the contact points **86** and **87**. Accordingly, the external circuit common to terminal portions **108** and **109** is opened and the external circuit common to terminals **106** and **107** is closed by the bridging effect of conductive ring element **50**. If desired, the operating rod **14** may be now rotated in either direction so that previously mentioned external circuits may be established either by conductive segment element **44** or **47** dependent upon the direction of rotation of the actuating knob **17**. In a like manner when the actuating handle **17** is released by the operator, the compressive efforts of spring **30** and the torsional efforts of spring **28** automatically return the circuit controller and in turn the operating rod and the electrical switch assembly to their normal neeutral position as shown in FIGS. 1 and 2.

It will be understood that the number of movable and stationary contacts may be increased or decreased, and therefore, it is understood that greater or lesser than five external circuits may be effectively controlled. In addition, it is apparent that the particular disposition of the movable and stationary contacts may be readily changed to meet the needs of any situation. For example, the conductive segments **44** and **47** may be interchanged and/or reversed and also the conductive rings may be suitably relocated and replaced to vary the transfer switching function for any required operation.

Further, it will be appreciated that the unique three point bearing arrangement provides a mechanically stable

arrangement which substantially eliminates all contact bounce and electrical wear due to excess movement of the operating rod. The polished chrome sleeves **18** and **19** as well as the low frictional characteristic of the nylon sleeve **51** provide for reduced mechanical wear and permit easy manipulation of the actuating handle **17** by the operator. In addition, the concentric disposition of the insulative sleeve and conductive ring and segment elements provides for reduced wear of the electrical contact points which improves the electrical characteristics of the circuit controller. The use of the printed board eliminates the possibility of a wiring error in hooking-up the circuit controller to the external circuit. The unique disposition of the terminal portions permits the female terminal connector to be rotated 180 degrees without resulting in an erroneous electrical hook-up. Accordingly, each of these features provides an improved overall circuit controller which is economical in cost, simple in construction, reliable in operation, durable in use, and efficient in service.

While my invention has been described with reference to a preferred single embodiment thereof, it should be understood that numerous changes and variations may be made by those skilled in the art that will fall within the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. A push-pull-rotary circuit controller comprising, a supporting bracket having a plurality of bearings disposed in axial alignment with each other, an operating rod journaled in said bearings, said operating rod having an actuating handle mounted on one end and having a movable contact assembly including a plurality of electrically isolated contact elements axially disposed on the other end thereof, a fixed contact assembly having a printed circuit board securely fastened to said supporting bracket, said printed circuit board having a plurality of terminal portions for connection to external circuits and carrying a plurality of spring contacts disposed in cooperative association with said contact elements, and a return-to-neutral spring biasing assembly disposed intermediate the ends of said operating rod for permitting said actuating handle to be pushed, pulled and rotated in either direction thereby selectively establishing and interrupting electrical contact between said contact elements and said contact springs and thereafter for returning the circuit controller to a normally neutral position.

2. A push-pull-rotary circuit controller as defined in claim **1**, wherein said movable contact assembly includes a plurality of tubular insulative elements telescoped over the other end of said operating rod for electrically isolating said contact elements.

3. A push-pull-rotary circuit controller as defined in claim **2**, wherein the peripheral surface of said tubular insulative elements and the outer surface of said contact elements are substantially coincidental thereby providing a relatively even contacting surface area for said spring contacts.

4. A push-pull-rotary circuit controller as defined in claim **1**, wherein said plurality of spring contacts are arranged in pairs for being selectively electrically bridged by said contact elements.

5. A push-pull-rotary circuit controller as defined in claim **1**, wherein said plurality of bearings includes a first bearing located at the one end of said operating rod, a second bearing located at the other end of said operating rod, and a third bearing located intermediate the ends of said operating rod.

6. A push-pull-rotary circuit controller as defined in claim **5**, wherein said return-to-neutral spring biasing assembly is disposed between said first and third bearings and includes a compression spring, a torsion spring and a sector plate for returning the circuit controller to its neutral position.

7. A push-pull-rotary circuit controller as defined in claim **6**, wherein said sector plate includes an axially extending pin and said third bearing includes an axially extending pin which cooperates with the respective ends of said torsion spring for rotatably returning the circuit controller to its neutral position.

8. A push-pull-rotary circuit controller as defined in claim **7**, wherein the flat surfaces of said sector plate cooperate with said supporting bracket to limit the amount of rotational movement in either direction.

9. A push-pull-rotary circuit controller as defined in claim **7**, wherein the respective ends of said torsion spring are carried by a spool of low friction material which is slidably disposed on said axially extending pin of said sector plate.

10. A push-pull-rotary circuit controller as defined in claim **5**, wherein said first bearing comprises a threaded bushing fixedly secured to the front end of said supporting bracket for securing the circuit controller to a mounting panel.

11. A push-pull-rotary circuit controller as defined in claim **10**, wherein a cylindrical sleeve is disposed within such threaded bushing and extends slightly beyond the front end of said threaded bushing so that said operating rod may be pushed inwardly to the extent in which the actuating handle engages the front end of said threaded bushing.

12. A push-pull-rotary circuit controller as defined in claim **5**, wherein a cylindrical sleeve is disposed within said third bearing and extends slightly beyond the back end of said third bearing so that said operating rod may be pulled outwardly to the extent in which a stop member engages the back end of said third bearing.

13. A push-pull-rotary circuit controller as defined in claim **1**, wherein said plurality of contact elements comprise a plurality of circular segment and ring contacts for electrically contacting said contact springs.

14. A push-pull-rotary circuit controller as defined in claim **1**, wherein a cover member is telescoped over said supporting bracket and said bearings to protect said spring contacts and contact elements.

15. A push-pull-rotary circuit controller as defined in claim **13**, wherein said operating rod includes an axially extending slot for providing a self-indexing arrangement for said circular segment contacts.

16. A circuit controller comprising, an L-shaped supporting bracket, a threaded bushing securely fastened to one leg of said L-shaped supporting bracket and a metallic and a nonmetallic bearing block disposed intermediate and at the free end of the other leg of said L-shaped supporting bracket, respectively, an operating rod passing axially through said bushing, said metallic bearing block and said nonmetallic bearing block, said operating rod having an actuating handle on one end for longitudinal and rotational manipulation, a return-to-neutral biasing assembly having a compression spring, a torsion spring, and a sector return plate surrounding said rod and disposed between said bushing and said metallic bearing block, a first axially extending pin secured to said sector return plate, a second axially extending pin secured to said metallic bearing block, a spool slidably disposed on said latter pin, a transfer switching assembly having a plurality of movable and stationary contacts disposed between said metallic and said nonmetallic bearing blocks, said movable contacts include a plurality of ring and segment conductive elements surrounding said operating rod and axially disposed in insulative relation by means of a plurality of insulative spacer sleeves telescoped over said operating rod, said stationary contacts include a plurality of conductive pairs of spring contact fingers disposed on each side of said operating rod in cooperative association with said ring and segment conductive elements of said movable contacts, said conductive spring contact fingers electrically connected to and carried by a printed circuit board which is securely fastened to said other leg of said L-shaped supporting bracket, said printed circuit board including terminal portions for connection to external circuits which are completed and interrupted in accordance

with the longitudinal and rotational manipulation of said actuating handle which causes the opening and closing of said stationary contacts by said movable contacts.

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