

Sept. 10, 1946.

J. G. OETZEL

2,407,509

CIRCUIT CONTROLLER

Filed Oct. 25, 1943

3 Sheets-Sheet 1

Fig. 1

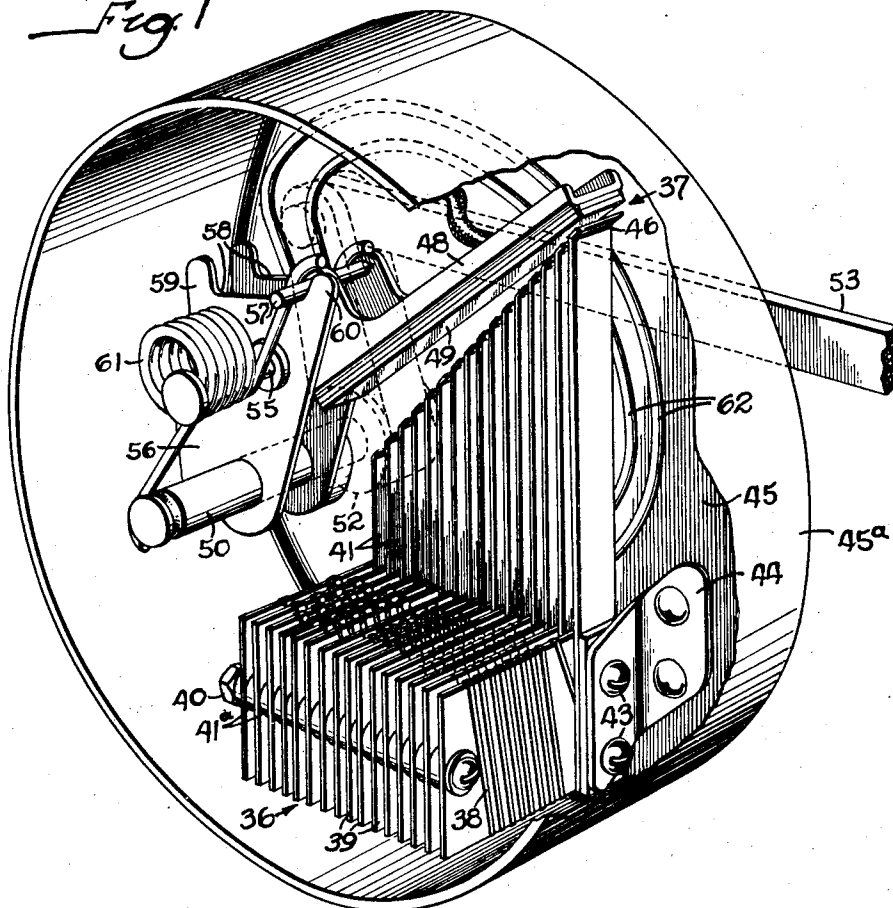
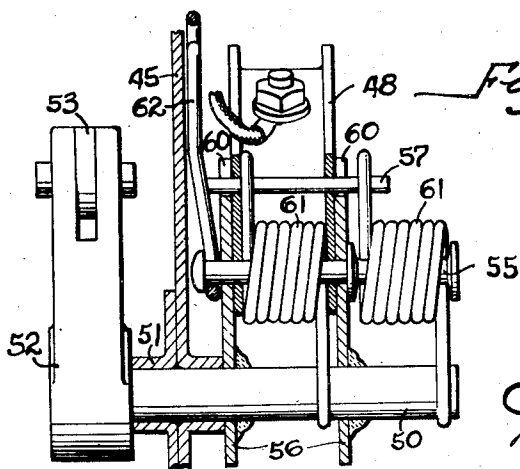


Fig. 2



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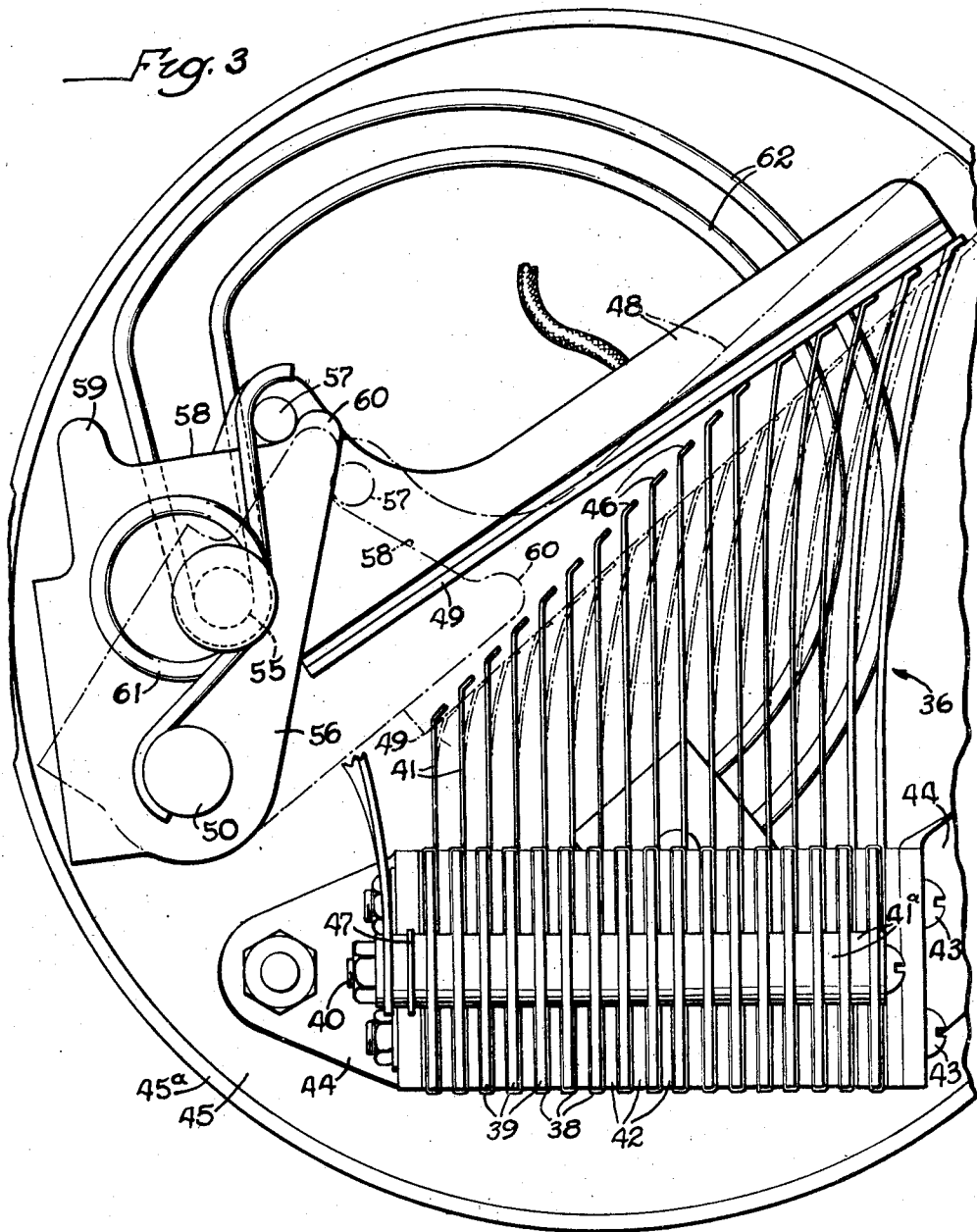
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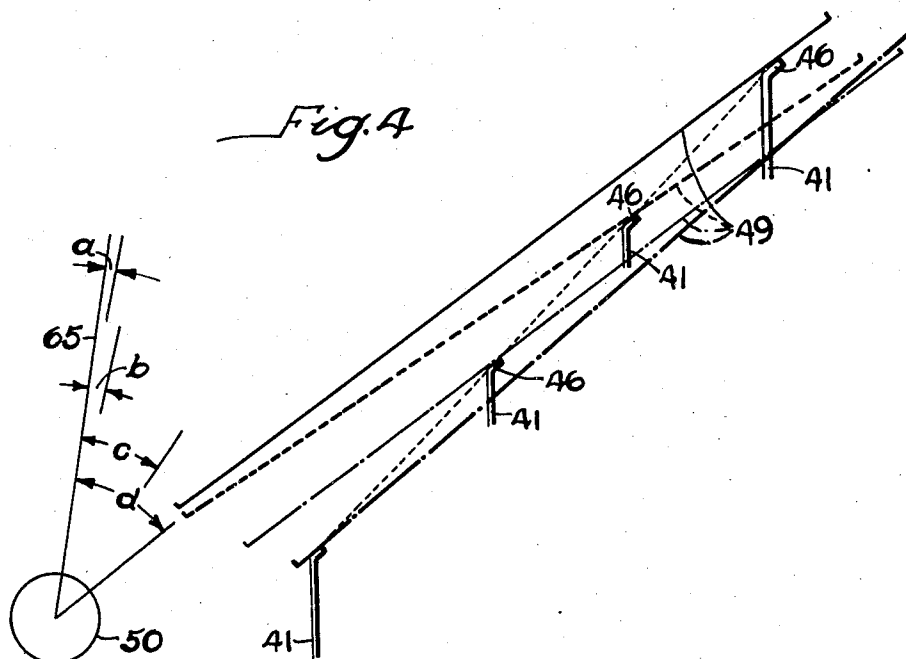
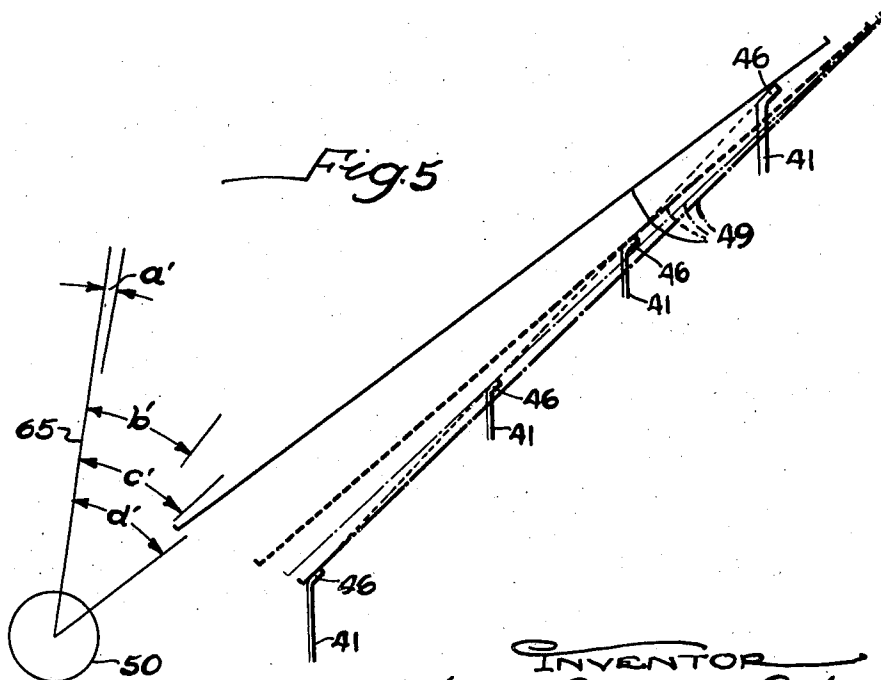
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,407,509

CIRCUIT CONTROLLER

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Application October 25, 1943, Serial No. 507,548

13 Claims. (Cl. 200—1)

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This invention relates to mechanism for controlling the current flow in an electric circuit, and constitutes an improvement in the mechanism of the type disclosed in Patent No. 1,952,679, in which contacts are engaged successively in the movement of a common contact member.

One object is to provide a step-by-step controller of the above character in which the movement of the contact member to engage the first contact is reduced to a minimum.

Another object is to provide for the engagement and disengagement of the different contacts in different positions of the contact member while the latter is moving in opposite directions.

The invention also resides in the novel structural character of the means for obtaining the differential action above referred to.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

Figure 1 is a fragmentary perspective view of the improved controller.

Fig. 2 is a fragmentary section taken along the line 6—6 of Fig. 1.

Fig. 3 is an enlarged elevational view of the controller-contact mechanism.

Figs. 4 and 5 are partial views illustrating different positions of the contact mechanism.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawings and will herein describe in detail the preferred embodiment. It is to be understood, however, that I do not intend to limit the invention by such disclosure but aim to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

In the exemplary form shown, the improved controller comprises a rheostat having a multiple element resistance unit 36 and a contact mechanism 37 mounted on the end wall 45 of a casing having a peripheral wall 45^a and a cover (not shown). The unit is composed, in the present instance, of a plurality of relatively thin plates 39 of insulating material around each of which is wound a resistance element 38 in the form of a flat Nichrome wire. The plates are separated by metallic spacers 41^a which are clamped against the ends of the respective wires by a bolt 40 which constitutes the common rheostat terminal.

Between the other ends of the plates are contact blades in the form of leaf springs or strips 41 which are separated by insulating spacers 42

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and respectively clamped against the insulated ends of the respective wires 38 by bolts 43 which extend through brackets 44 by which the unit 36 is supported rigidly from the casing wall 45. A cantilever mounting is thus provided for each blade. The blades project in spaced parallel relation laterally from the plates 39 and are of progressively increasing lengths so that their free bent ends 46 lie substantially in a straight line when the blades are released. Herein, there are seventeen blades, and the sixteen longest ones are connected to the corresponding resistance elements 38. The shortest blade is connected directly to the terminal bolt 40 by a conductor instead of a resistance wire.

The blades are made of resilient metal such as Phosphor bronze preferably about .020 of an inch thick, the two longest strips being of somewhat greater thickness, .040 of an inch in the present instance. The bent ends 46 constitute contacts which are engaged successively with a wiping action during the advance of a rigid flat bridging contact 49 which extends transversely of and overlaps the free ends of the blades and is adapted, when moved bodily and broadwise toward these ends, to abut against the ends successively and flex the engaged strips laterally in its continued advance. In this way, the resistance elements 38 corresponding to the engaged contacts are connected in parallel between the terminal 40 and plate 49. The latter constitutes the other rheostat terminal, and is insulated from and mounted on an arm 48 so as to move broadwise toward the contact ends 46 as the arm is swung in one direction. Through a novel connection described later, the arm 48 is floatingly mounted and adapted to be actuated by turning of a shaft 50 journaled in a bearing 51 in the casing wall 45 and carrying on its outer end an arm 52 which is connected by a link 53 to a member by which the rheostat is to be actuated.

The mounting for the arm 48 is such that in one direction of turning of the shaft 50, the contact 49 is carried from the released position shown in Fig. 1, toward and against the blade ends 46, first engaging the longest blade and then the successively shorter blades as the turning of the shaft continues. The mounting allows some degree of bodily floating movement so that during the return motion of the actuating shaft, each of the strip ends 46 is disengaged by the contact 49 at a position of the shaft farther from the released position than the position of engagement during the advance of the shaft.

Such action of the contact in engaging and

disengaging the strip ends is obtained in the present instance by pivoting the arm 43 on a pin 55 spaced from the actuating shaft 50 and also laterally from the contact plate 49 on the side thereof opposite from the contacts 45 and beyond the end that engages the shortest blade 41. The pivot pin is supported by two plates 56 fast on the shaft 50 which lie against opposite sides of the arm 43 so as to hold the latter against lateral displacement. Beyond the pivot 55, the arms 56 have a lost motion connection with the arm 48 which, for this purpose, carries a cross-pin 57 that rides along slots 53 formed in the arms 56 between stop lugs 59 and 60. Torsion springs 61 are coiled around the pin 55 and act between the shaft 50 and the pin 57 to urge the latter toward the lug 60 (Fig. 3).

A return spring 62, anchored at one end on the casing wall 45 and acting at the other end on the pin 55, urges the shaft 50 and the parts thereon counterclockwise as viewed in Figs. 1 and 2 so that when the actuating member is released to the limit position determined by engagement of a lug 59 with the casing wall 45^a, the free end of the contact plate 49 will be spaced from but disposed adjacent to the end of the longest blade 41 and inclined away at a small angle from the ends of the successively shorter strips, being at the same time urged by the springs 61 to its limit clockwise position relative to the plates 56. Now, as the actuating shaft 50 is turned clockwise, the longest blade 41 is engaged first and bends in the continued movement of the rigid contact 43 as the second and succeeding blades are engaged to interpose their respective resistance elements 30 in the circuit.

The reactionary force of the initially engaged blades to continued advance of the contact increases until after a number, five in this instance, of the blades have been picked up, the force of the springs 61 is overcome, and the arm 43 is allowed to swing counterclockwise relating to the arms 56. This movement, however, increases the force of the springs 61 so that the stress of the bent blades is overcome, and the contact 43 is allowed to advance and engage the remaining successively shorter blades progressively. While the springs 61 are thus yielding, the contact 43 is shifted endwise and outwardly to some extent producing a desirable rubbing action between the engaged contact surfaces. Also, the effective line of action of the reactionary force applied by the engaged blades 41 shifts inwardly so that the actuating force applied to the contact 49 by the springs 61 causes the contact in effect to pivot about the ends of the longer blades as the shorter blades are being picked up. As a result, all of the engaged blades remain in firm contact with the plate 49, and the amount of the bending of the longer blades is minimized.

With the contact plate 49 floatingly mounted and actuated as above described, its advance to pick up the successive blade ends 45 involves turning on the pivot 55 and also some endwise shifting of the plate. Accordingly, the force applied to the plate must be sufficient not only to further bend the previously engaged blades 41, but also must overcome the friction at the pivot 55 and between the blade ends and the plate. On the return motion, however, these friction forces need not be overcome. Actually, they assist the bent blades in moving the plate 49 backwardly as permitted by retraction of the actuating shaft 50. As a result, the contact plate assumes different positions relative to the actuating

shaft than during the advancing movement of the plate. That is to say, the plate will, during its return movement, disengage any one of the blade ends 45 in a position of the shaft 50 advanced from the position at which the same blade was engaged during depression of the pedal 37. In other words, the positions of the shaft 50 at which any strip end is first engaged by the contact 49 will be angularly spaced from the released position 65 (Figs. 4 and 5) a shorter distance than when the same blade end is disengaged on the return movement of the shaft.

As shown in Fig. 4, the end 45 of the longest blade 41 is engaged after clockwise turning of the shaft through an angle a and advance of the contact face 49 to the full line position. Then, in the continued advance of the shaft through the angle b and movement of the contact face to the dotted position, the fifth blade is engaged and the springs 61 start to yield before the sixth blade is picked up as shown in full lines in Fig. 3. When the shaft has turned through the angle c , the eleventh blade is engaged as shown by the double dot-dash position of the contact 49. Finally, after the shaft has advanced through an angle d , the contact face, as shown in dot-dash outline (Fig. 4), engages the last or shortest blade, and all of the blade ends are bent as shown in phantom in Fig. 3. During the return movement, however, different angular positions, as shown in Fig. 5, are assumed by the contact face, and the last, the eleventh, the fifth, and the first blades are disengaged successively with the shaft 50 spaced at angles d' , c' , b' , and a' from the released position 65.

The result of the differential action above described in engaging and disengaging the blades results in a different actuator movement vs. current characteristics during the advance and return motions. This action is desirable in offsetting the hysteresis behavior of certain magnetic devices with which the present rheostat may be used advantageously.

It will be observed that the pivot 50 about which the arm 43 swings to pick up the first contact blade is spaced on the side of the bank of blades remote from the longest blade. Therefore, a minimum movement of the actuating shaft 50 is required in order to effect engagement of the first contact and closure of the electric circuit controlled by the rheostat.

I claim as my invention:

1. In a circuit controller, a contact mechanism combining a plurality of elongated flexible contact members disposed side by side, means providing a cantilever mounting for one end of said members, said members projecting progressively increasing distances from said mounting with their free ends substantially aligned, an arm mounted to swing about a fixed pivot extending transversely of and spaced along said contact line beyond the shortest of said strips, a second arm carrying a contact surface and pivoted on said first arm to swing about an axis spaced from said first axis and farther from said contact line than the first axis, means providing a lost motion connection between said arms, and spring means acting on said second arm and urging the latter relative to the first arm in a direction to advance said contact surface toward said free contact ends.

2. In a circuit controller, a contact mechanism combining a plurality of elongated flexible contact strips disposed side by side, means providing a cantilever mounting for one end of said strips,

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said strips projecting progressively increasing distances from said mounting with their free ends substantially aligned, a member mounted for movement toward and away from said free ends, an arm pivotally mounted on said member and resiliently urged relative thereto in a direction toward said free ends, means limiting the extent of the latter movement, and a contact surface carried by said arm and movable during the in conjoint movement of said arm and member into abutment with a plurality of the longer of said strips, and then into abutment with the progressively shorter strips during yielding of the arm relative to the member as the movement of the latter is continued.

3. In a circuit controller, a contact mechanism combining a plurality of elongated flexible contact strips disposed side by side, means providing a cantilever mounting for one end of said strips, said strips projecting progressively increasing distances from said mounting with their free ends substantially aligned, a member mounted for movement toward and away from said free ends, an arm pivotally mounted on said member and having a lost motion connection therewith, resilient means urging said arm toward said ends, and a contact surface carried by said arm and first engaging the longest of said strips and then engaging the free ends of the other strips successively in the advance of said member.

4. In a circuit controller, the combination of a plurality of elongated metal strips arranged in spaced parallel relation with one end of each strip rigidly supported, a substantially rigid contact surface extending transversely of and overlapping at opposite ends of all of said strips and adapted when moved bodily and broadwise toward the free ends of said strips in a direction generally longitudinally of but at an angle relative thereto to abut against said ends successively and flex the strips laterally in its continued movement, an actuating member movable away from and back toward a normal released position, means supporting said contact surface on said member for movement into different angular positions relative to said member, and means resiliently urging said surface in one direction relative to said member.

5. In a circuit controller, the combination of a plurality of elongated metal strips arranged in spaced parallel relation with one end of each strip rigidly supported, a substantially rigid contact surface extending transversely of and overlapping at opposite ends of all of said strips and adapted when moved bodily and broadwise toward the free ends of said strips to abut against said ends successively and flex the strips laterally in its continued movement, a member mounted for movement away from and back toward a normal released position and supporting said contact surface for movement relative to the member and toward and away from said ends, and a resilient lost motion connection between said surface and said member operable to transmit the movement of said member resiliently to said surface while permitting yielding of the surface relative to said member.

6. In a circuit controller, the combination of a plurality of elongated metal strips arranged in spaced parallel relation with one end of each strip rigidly supported, a substantially rigid contact surface extending transversely of and overlapping at opposite ends of all of said strips and adapted when moved bodily and broadwise toward the free ends of said strips in a direction

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generally longitudinally of but at an angle relative thereto to abut against said ends successively and flex the strips laterally in its continued movement, an actuating member movable away from and back toward a normal released position, and mechanism connecting said member and said surface and operable to move the latter into engagement with certain of said strips at one position of said member and out of engagement with the same strip at a different position of the member in the return movement thereof.

7. In a circuit controller, the combination of a series of elongated resilient contact arms supported at one end in parallel relation, a bridging contact extending across the free ends of said arms for broadwise engagement therewith, an actuating member movable progressively away from and back toward a normal released position, and mechanism connecting said member and said contact and operable to move the contact into engagement with the successive arms at successive positions in the advance of said member and out of engagement with the same arms in different positions of said member during the return movement thereof.

8. In a circuit controller, the combination of a series of elongated resilient contact arms supported at one end in parallel relation, a bridging contact extending across the free ends of said arms for broadwise engagement therewith, an actuating member movable progressively away from and back toward a normal released position, and mechanism connecting said member and said contact and operable to move the contact into engagement with the successive arms at successive positions in the advance of said member and out of engagement with the same arms in different positions of said member during the return movement thereof, said latter positions of said member being spaced farther away from the released position thereof than said advancing positions.

9. In a circuit controller, the combination of a series of contacts laterally spaced from each other along a line, a bridging contact member extending along said line adjacent to the latter for engagement with the contacts successively during movement of said member in one direction and for disengagement with the contacts successively but in reverse order during reverse movement of the member, an actuating member movable away from and back toward a normal released position to advance and retract said contact member, and mechanism connecting said members and operable to advance said contact member into engagement with successive ones of said contacts at successive positions in the advance of said actuating member and out of engagement with the same arms in different positions of said actuating member during the return movement thereof.

10. In a circuit controller, the combination of a series of contacts laterally spaced from each other along a line, a bridging contact member extending along said line adjacent to the latter for engagement with the contacts successively during movement of said member in one direction and for disengagement with the contacts successively but in reverse order during reverse movement of the member, an actuating member movable away from and back toward a normal released position to advance and retract said contact member, and mechanism connecting said members and operable to cause disengagement of a certain one of said contacts at a position of

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said actuating member spaced farther from said released position than the position of engagement of the contact member and the same contact.

11. In a circuit controller, a contact mechanism combining a plurality of elongated flexible contact members disposed side by side, means providing a cantilever mounting for one end of said members, said members projecting progressively increasing distances from said mounting with their free ends substantially aligned, an arm pivotally supported to swing in a plane including said members and about an axis disposed adjacent but spaced outwardly from the shortest of the members, and a current conducting surface on said arm adapted during movement toward the ends of said members to abut against the end of the longest member first and then in its continued movement to contact the ends of the other members successively, the ends of all of the engaged members being bent laterally away from the pivotal axis of said arm.

12. In a circuit controller, a contact mechanism combining a plurality of elongated flexible contact members disposed side by side, means providing a cantilever mounting for one end of said members, said members projecting progressively increasing distances from said mounting with their free ends substantially aligned, a bridging contact extending across said free ends, means providing a pivot disposed adjacent the shortest projecting one of said members, and means supporting said contact for movement about said

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pivot to carry the contact surface broadwise toward said free ends in a direction to abut against the end of the longest member first and then in its continued movement to contact the ends of the other members successively, the ends of all of the engaged members remaining bent.

13. In a circuit controller, a contact mechanism combining a bank of resilient contact strips supported at one end in parallel relation and having their free ends in general alinement, an actuating arm pivoted for movement toward and away from the free ends of said strips, a contact arm pivoted to said operating arm and having a substantially flat contact plate which overlies the free ends of said strips, a resilient connection between said arms for opposing relative pivoting therebetween, said arms being so arranged that rotation of said actuating arm in the advancing direction not only produces bodily movement of said contact plate abuttingly against the successive ends of said strips but also produces a wiping of said plate across the successively engaged ends, the surfaces of wiping engagement being sufficiently extensive and frictional in nature so that for a given position of said contact plate said resilient connection will have to oppose a greater force and therefore allow a different angular relationship to exist between said arms when said actuating arm is being advanced than when it is being moved in the reverse direction.

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