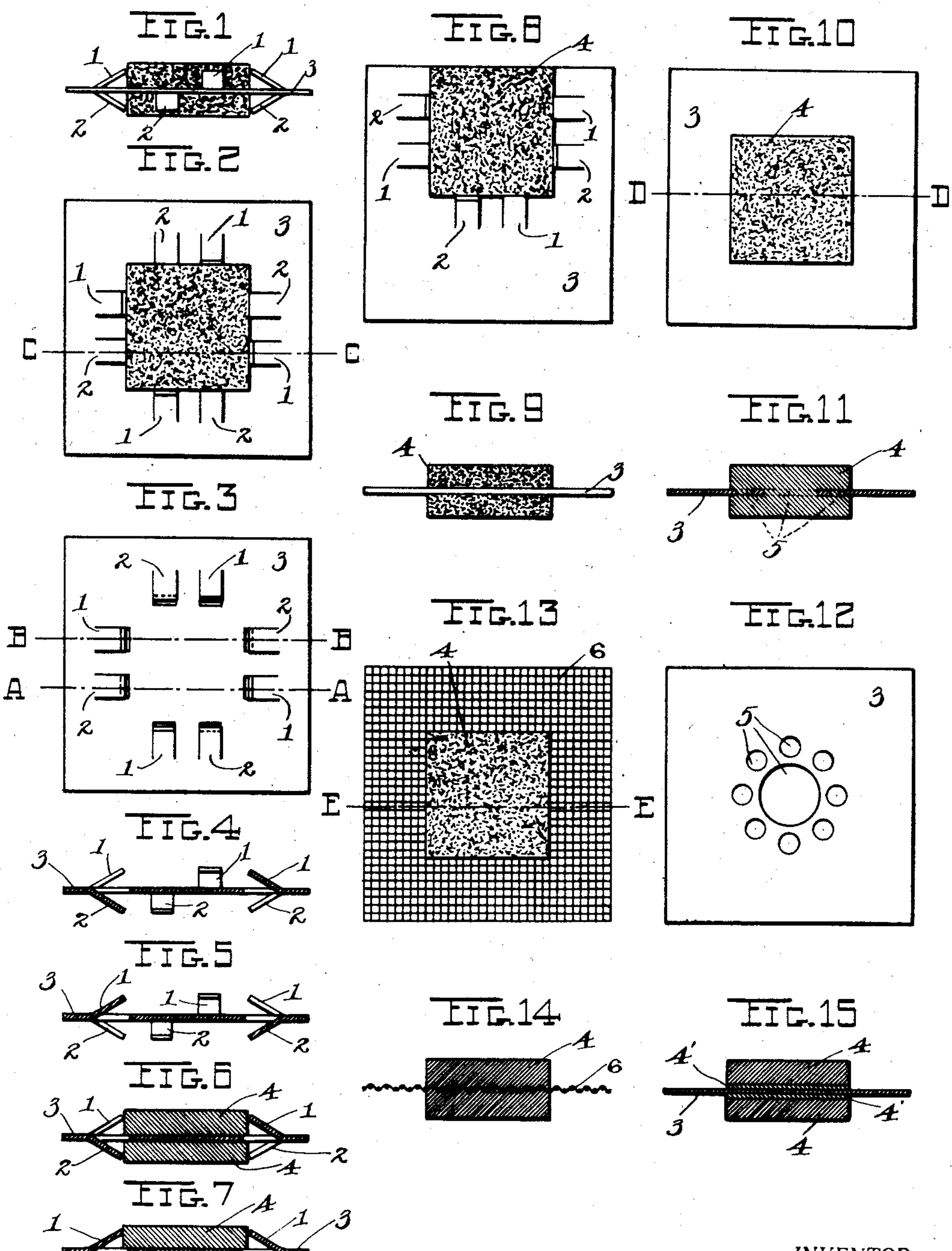
E. L. CLARK.

COMPRESSION RHEOSTAT.

APPLICATION FILED MAY 19, 1915.

1,222,182. Patented Apr. 10, 1917.

3 SHEETS—SHEET 1.



WITNESS

H. G. Grover

INVENTOR.

EMERSON L. CLARK

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ATTORNEY

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3 SHEETS—SHEET 2.

FIG.16

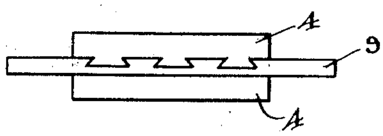


FIG.18

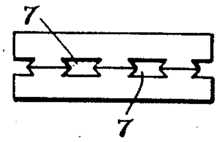


FIG.17

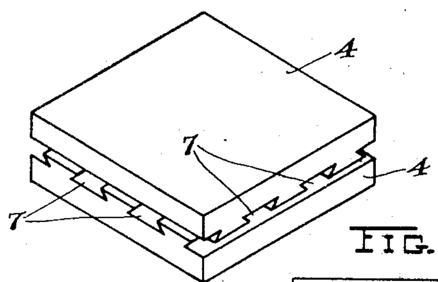


FIG.19

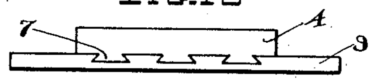


FIG.22

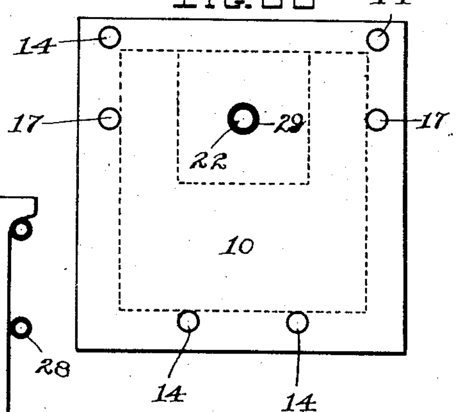


FIG.23

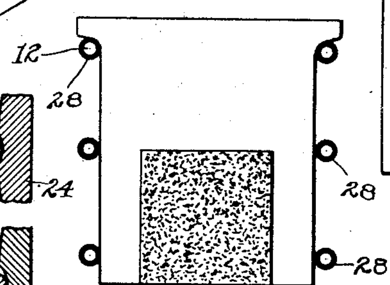


FIG.25

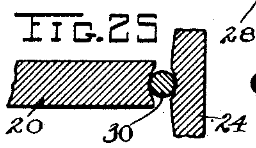


FIG.24

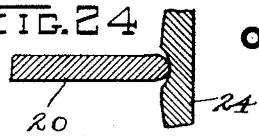
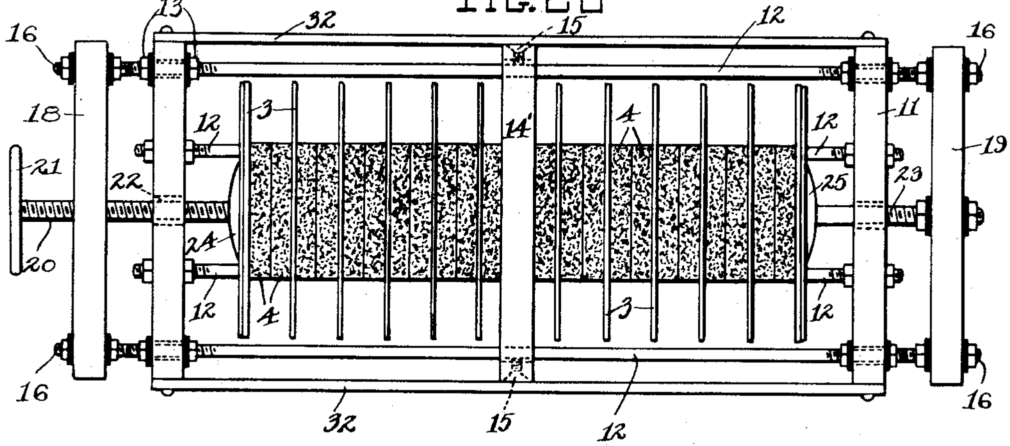


FIG.26



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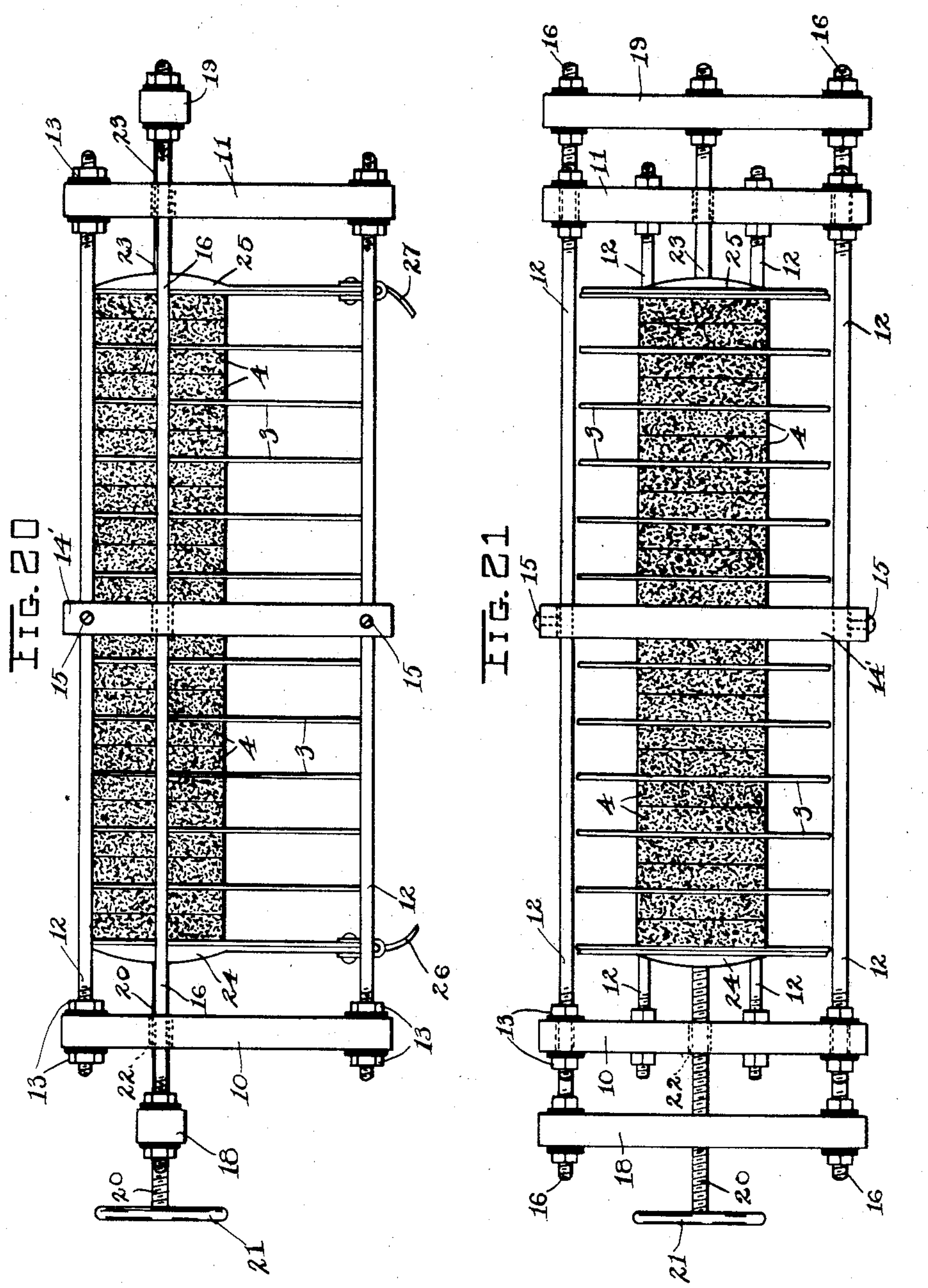
3 SHEETS—SHEET 3.



WITNESS
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ATTORNEY

UNITED STATES PATENT OFFICE.

EMERSON L. CLARK, OF LAKEWOOD, OHIO, ASSIGNOR TO NATIONAL CARBON COMPANY, A CORPORATION OF NEW JERSEY.

COMPRESSION-RHEOSTAT.

1,222,182. Specification of Letters Patent. Patented Apr. 10, 1917.

Original application filed May 31, 1912, Serial No. 700,558. Divided and this application filed May 19, 1915. Serial No. 29,051.

To all whom it may concern:

Be it known that I, EMERSON L. CLARK, a citizen of the United States, residing at Lakewood, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Compression-Rheostats, of which the following is a full, clear, and exact description.

This application is a division of my application Serial No. 700,558, filed May 31, 1912, patented June 22, 1915, No. 1,143,810.

This invention relates to rheostats of the compression type in which the resistor elements consist of carbon, graphite or mixtures of these substances with other materials. However, the invention is not limited to the use of any specific materials, and hence may embrace resistors composed of any materials.

One object of my invention is to construct a rheostat with readily replaceable resistor units each having means rigidly attached thereto for radiating the heat.

Another object is to construct a rheostat with slight frictional resistance movement so that the elements when compressed, or released from pressure, will all move in unison.

Other objects will appear in the appended description.

Referring to the figures:

Figure 1 is an end view of a resistor element.

Fig. 2 is a plan view of the element shown in Fig. 1.

Fig. 3 is a plan view of the radiating plate before the carbon or composition blocks are attached thereto.

Fig. 4 is a sectional view of the radiating plate taken on the line A—A of Fig. 3.

Fig. 5 is a sectional view of the radiating plate taken on the line B—B of Fig. 3.

Fig. 6 is a sectional view of the resistor element and radiating plate taken on the line C—C of Fig. 2.

Fig. 7 is a sectional view of a modification showing a resistor element having only one composition block.

Fig. 8 is a plan view of another modification in which the composition blocks are arranged at one side of the radiating plate.

Fig. 9 is an end view of another modification.

Fig. 10 is a plan view of the resistor element shown in Fig. 9.

Fig. 11 is a sectional view of the resistor element taken on the line D—D of Fig. 10.

Fig. 12 is a plan view of the radiating plate shown in Figs. 9, 10 and 11.

Fig. 13 is a modification similar to that shown in Figs. 9, 10, and 11 in which a gauze radiating plate is used.

Fig. 14 is a sectional view of the resistor element taken on the line E—E of Fig. 13.

Fig. 15 is a modification in which the composition blocks are cemented to the radiating plate.

Fig. 16 is a modification in which the radiating plate is cast in grooves in the composition blocks.

Fig. 17 is an isometric view of the composition blocks of Fig. 16 before the plate is cast therein.

Fig. 18 is an end view of the modification shown in Fig. 17 with the grooves arranged parallel.

Fig. 19 is a modification showing a resistor consisting of one block with a radiating plate cast in grooves therein.

Fig. 20 is a side elevation of the rheostat in which the resistor elements are used.

Fig. 21 is a plan view of the rheostat shown in Fig. 20.

Fig. 22 is an elevation of the end plates of the rheostat shown in Figs. 20 and 21.

Fig. 23 is a modification of Figs. 20 and 21 in which the resistor element is suspended on parallel bars.

Fig. 24 is a partial sectional view of the point of support of the screw rod against the end plate.

Fig. 25 is a partial sectional view of another modification for communicating pressure.

Fig. 26 is a plan view of a modification of the rheostat shown in Figs. 20 and 21.

Referring to Figs. 3, 4 and 5, lugs 1 are punched in a plate 3 so as to extend on one side thereof. These alternate with lugs 2 punched so as to extend on the other side of the plate. Composition blocks 4 are then placed between the lugs, one on each side of the plate. The lugs are then firmly pressed against or into the composition blocks as is shown in Fig. 6. This arrangement provides for a very rigid resistor having a radiating plate in good contact with the sides of the composition blocks.

In order to prevent the metal from oxidizing and producing an undesirable resistance at the contact surface, the metal plate is coated with some metal that will not oxidize readily under the heat to which the element will be subjected in practice. The plate is preferably coated with nickel, though copper or other metal may be used.

In Fig. 7 a modification is shown in which lugs 1 are punched only on one side of the plate. The resistor element then consists of only one block in connection with each radiating plate.

In Fig. 8 a modification is shown in which the composition block or blocks are placed near one edge of the radiating plate. The advantage of this arrangement will be explained later.

In Figs. 9, 10, 11 and 12 a modification is shown in which the composition materials are pressed into and through holes 5 in the radiating plate 3, as shown in Fig. 12. The holes punched in the radiating plate may be of various shapes and sizes and the arrangement of the holes may be varied as desired. The plate and composition material properly mixed with a suitable binder are placed in a mold and put under hydraulic or other pressure which forces the material in intimate contact with the parts of the radiating plate as is shown in Fig. 11.

In Fig. 13 the radiating plate 3 is displaced by the gauze plate 6. The material forming the block 4 is pressed around the wires in the gauze plate in the same manner as has been described in the modification in Figs. 10, 11 and 12. The cross section of this type of resistor element is shown in Fig. 14.

In Fig. 15 the composition blocks are either brazed or cemented to the radiating plate 3. The brazing material or conducting cement is shown at 4′, the thickness being exaggerated somewhat to make the construction clear. When the blocks are to be brazed to the plate they are first coated on one side with copper or other metal and then the plating is joined to the plate by brazing in the usual manner. When the blocks are cemented to the plate they need not be copper coated. Conducting cements are well known in the art, and as a typical example the following may be given: 100 parts graphite, 40 parts bronze powder and enough glucose or sugar and water to make a stiff paste. The paste can be applied to either the plate or the resistor and the two parts pressed together in proper relation. They are then baked to a sufficient temperature to carbonize the glucose or sugar. After baking it will be found that the cement is conductive and will firmly join the resistor to the plate. The shape of the blocks and plate in Fig. 15 is the same as is shown in prior figures with the exception that the plate has no notched lugs.

In Figs. 16 and 19 the composition blocks 4 have undercut corrugations or grooves 7 extending across one side. The blocks are placed in a proper mold with the grooved surfaces in contact or closely adjacent and with the grooves of the one block running approximately at right angles to those of the other, and molten metal is poured in so that it will entirely fill all the grooves in the plate and form a radiating plate 9 as shown in Fig. 16. The mold, of course, will be arranged in well known ways so that this plate can be cast. It is obvious that the plates shown in Figs. 16 and 19, as well as those in the other figures, may be square, circular or any other shape.

The blocks need not be necessarily arranged with the grooves at right angles. They may be arranged at various angles or they may be parallel. Fig. 18 shows the latter arrangement. The preferable arrangement however, is with the grooves approximately at right angles.

The material used for casting may be iron, copper, zinc, aluminum or any other metal or alloy. The material may be cast in the blocks by pressure casting in a manner well known in the art.

In Fig. 19 a resistor is shown consisting of only one block with undercut grooves and a radiating plate cast therewith.

Referring to Fig. 20, a rheostat is shown in which the resistor elements are used. End plates 10 and 11 are joined by four rods 12 passing through holes 14 in the end plates (Fig. 22) and properly fastened by the nuts 13. The shape of the plates and the arrangement of the holes is shown in Fig. 22. In the center a plate 14′, somewhat similar to plates 10 and 11, is fastened rigidly to the rods 12 by screws 15 or by other appropriate means.

Insulated rods 16 pass loosely through holes 17 in the plates 10, 11 and 14′ and are fastened at each end of the rheostat to bars 18 and 19. A screw 20, having an appropriate wheel 21 fastened thereto, is threaded through the bar 18 and passes loosely through the hole 22 in the plate 10. The pin 23 is fastened to the bar 19 and extends loosely through a hole in the plate 11. The resistor elements can be readily inserted or removed so that a defective one can be replaced without trouble.

The type of resistor elements in Figs. 20 and 21 is similar to that shown in Fig. 8, in which the composition blocks are secured at or near the top of the radiating plate. The blocks may be secured in any of the ways disclosed herein. Each resistor element is supported on the lower rods 12 by means of its radiating plate as shown in dotted lines in Fig. 22.

End plates 24, 25 are placed at each end of the rheostat. These plates must be rigid enough to transmit the pressure uniformly over the surface of the composition blocks when applied through the screw 20 and pin 23. The end plates are preferably larger than the resistor blocks, so as to have additional surface for radiating heat as shown in the figures. The end plates are supported by the lower rods 12 in the same manner as are the resistor elements.

The lower parts of the end plates and of the radiating plates of the resistor elements permit conductors to be clamped thereto and hence the elements may be arranged in parallel groups if desired. As shown in Fig. 20, the terminals 26 and 27 are clamped to the end plates 24 and 25 so that all of the elements are in series.

In order to prevent any of the elements from being short circuited the rods 12 and 16 may be covered with transite tubing or any other electrical insulating and heat insulating material as is shown in section at 28 in Fig. 23. It will be understood that insulating bushings and washers will be used where the rods are joined to the end plates 10 and 11, as is indicated in Figs. 20 and 21 by the parts shown in solid black. The holes 22 in the end plates 10 and 11 should be properly insulated by bushings 29 as is shown in Fig. 22. The insulation suggested is only one of many ways in which the short circuit may be prevented. Anyone skilled in the art could provide for properly insulating the parts, and hence these need not be gone into in detail.

The screw 20 should press against the plate 26 through a point or ball contact as is shown in Fig. 24. If the screw presses against a flat surface the rotative movement of the screw will cause the plate to reciprocate sidewise and produce undesirable fluctuations in the resistance of the rheostat.

In Fig. 25 another arrangement is shown whereby the end plate is not caused to move sidewise. Sockets formed in the plate 24 and the screw 20 contain a hardened ball 30 which may have a retainer to prevent it from dropping out.

The rheostat shown in Fig. 26 is essentially the same as that of Figs. 20 and 21 but has side pieces 32 made of insulating material such as transite for example. These members are fastened on both sides of the end members 10 and 11 to inclose the blocks on four sides whereby a chimney or draft effect is produced when the blocks become heated by the current traversing them.

The terminals 26 and 27 are shown connected to the end plates 24 and 25 so that the current traverses the composition blocks 4, the radiating plates, and the metallic plate 14′ in series. By rotating the wheel 21, the screw 20 forces the resistor elements on the left hand side of the rheostat against the plate 14′. The reaction transmitted through rods 16 presses the pin 23 against the plate 25 and compresses the resistor elements on the right hand side of the rheostat against the metal plate 14′. If the pile is compressed from one side only so that it would be, say ½ inch shorter than it originally was, the first block on the moving end of the pile would move ½ inch, and the succeeding blocks would move progressively less distances. If the pile is compressed from both ends as in applicant's case, the two outside blocks would move only ¼ inch and the succeeding ones progressively less. Hence to obtain the same resistance the average distance of movement of the blocks in one type is twice that of the other. In order to obtain gradual and uniform variation of resistance the movement must be uniformly transmitted through the entire pile. It is evident, therefore, that the changes of resistance should be obtained with as small movement of the blocks as possible. The arrangement shown in Figs. 20, 21 and 26 provides for such reduced movement.

If the resistor elements are compressed only from one side it takes a certain amount of movement of the first resistor block before pressure is transmitted to the last block, and hence at the first movements of the compression screw the last blocks will furnish a high contact resistance so that very unsatisfactory results will be obtained when the pressure is first applied and when it is about to be removed.

The relatively short compression rheostat therefore gives better results than a long one. By providing pressure at both ends I am enabled to use a rheostat of twice the length and obtain equal efficiency.

Since the resistor elements are supported on the rods 12 by means of radiating plates they pivot at the point of support and move about the pivotal point under compression and on release of pressure. This reduces the frictional resistance and hence the resistor elements move readily and provide for uniform variation of resistance. If the composition blocks were placed at the bottom of the radiating plates or near the middle, the mechanical resistance caused by the plates sliding along the rods 12 would prevent the elements from moving readily, and the variations of resistance would be irregular, especially at the point of maximum resistance. Of course, when the blocks are placed at the top of the radiating plates there will still be some sliding of the plates along the rods 12 at the pivotal points, but the movement is reduced, and by making the plates of sufficient size the movement will be negligible.

In Fig. 28 an arrangement is shown where the blocks are fastened to the base of the radiating plate. The resistor element is then supported on the upper bearing rods 12 by means of lugs or ears 31 at the upper edge of the radiating plate. It is obvious that this arrangement will allow of the resistor elements pivoting on the bearing rods in a similar manner to that previously described.

Having described my invention, what I claim is:—

1. A resistor element consisting of a metallic radiating plate and a block of carbon adjacent to the surface of the plate and fastened eccentrically thereto.

2. In electric rheostats, a radiating plate having punched lugs extending from both sides thereof and a resistance block held in place on each side of said plate by said lugs.

3. In electric rheostats, a radiating plate having punched lugs and a block of resistance material retained in place by said lugs.

4. In electric rheostats, a radiating plate consisting of iron, a coating of difficultly oxidizable metal thereon and a block of resistance material rigidly fastened to the plate.

5. In an electric rheostat, the combination of end plates, connecting means joining said plates, resistance blocks, radiating plates rigidly fastened to said blocks, said blocks and plates resting and pivoting on certain of said means, and means for forcing the blocks into contact.

6. In an electric rheostat, a plurality of independently movable resistors, each resistor consisting of resistance material secured to a radiating plate, means extending lengthwise of the rheostat for supporting the radiating plates, said plates having sufficient pivotal movement on the point of support to allow of the normal movement of the resistors.

7. In an electric rheostat, the combination of end plates, connecting means joining said plates, resistance blocks, radiating plates rigidly fastened to said blocks, means for pivotally supporting said blocks and plates between the end plates and means for compressing the blocks.

8. In an electric rheostat, the combination of end plates and side plates to form an inclosure, resistance blocks, radiating plates rigidly fastened to said blocks, means for pivotally supporting the blocks and plates within the inclosure and means for compressing the blocks.

9. In an electric rheostat, the combination of end plates and side plates to form an inclosure, resistance blocks mounted on radiating plates, means for pivotally supporting the blocks and plates, means for dividing said inclosure into two compartments and a member for simultaneously compressing the blocks in both compartments.

In testimony whereof, I hereunto affix my signature.

EMERSON L. CLARK.