J. G. KJELLGREN.

RHEOSTAT.

APPLICATION FILED JAN. 6, 1917. RENEWED NOV. 13, 1919.

**1,348,809.** Patented Aug. 3, 1920.

*Fig. 1.*

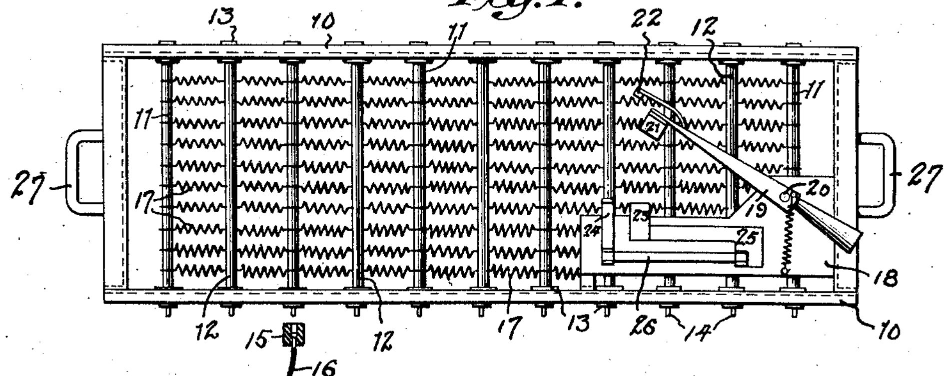



*Fig. 2.*

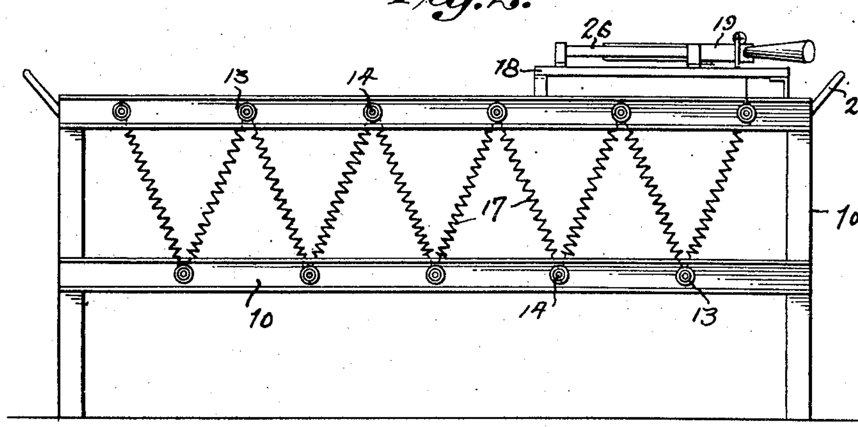



*Fig. 3.*

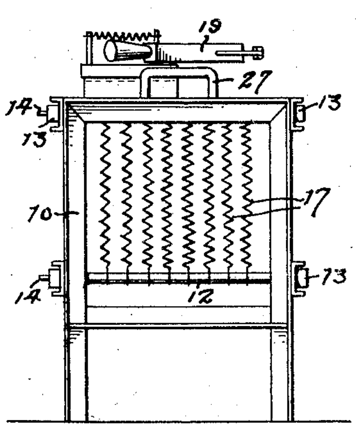
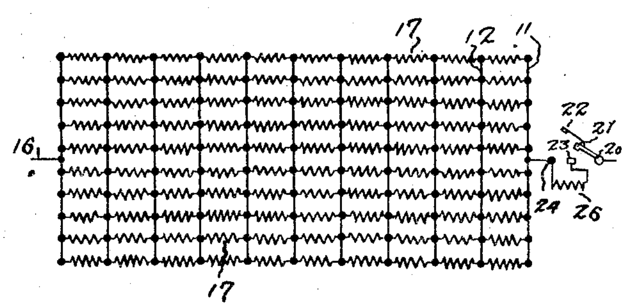



*Fig. 4.*

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# UNITED STATES PATENT OFFICE.

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## RHEOSTAT.

**1,348,809.** Specification of Letters Patent. **Patented Aug. 3, 1920.**

Application filed January 6, 1917, Serial No. 140,953. Renewed November 13, 1919. Serial No. 337,866.

*To all whom it may concern:*

Be it known that I, JOHN G. KJELLGREN, a citizen of the United States of America, and residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Rheostats, of which the following is a specification.

My invention relates to rheostats and the object of my invention is to provide a light, portable device capable of high duty without excessive heating, readily repaired and inexpensive to manufacture.

In the accompanying drawings,

Figure 1 is a plan view of a rheostat in which my invention is embodied in one form;

Fig. 2 is a side elevation thereof,

Fig. 3 is an end elevation; and

Fig. 4 is a diagrammatic plan of the wiring of the rheostat and its main control switch.

The present rheostat while possessing features of general value and utility, is designed particularly to afford an extremely light, fire-proof resistance device for heavy currents such as electric railway currents, and by which these currents may be reduced to suitable condition for use in electric welding—for example, in the welding of rail bonds. Work of the latter character requires a current of approximately one hundred and twenty-five to one hundred and fifty (125–150) amperes at fifty to sixty (50–60) volts. Inasmuch as the usual electric railway operating current employs approximately five hundred and fifty (550) volts, the rheostat must be able to dissipate the heat generated by a current of one hundred and fifty (150) amperes at five hundred (500) volts.

The rheostats now commonly used for work of this character, comprise as their resistance elements, cast iron grids, or a heavy wire or ribbon of resistance metal. These resistance elements are not only in themselves heavy, but they necessitate heavy supporting frames, with the result that the rheostat structure as a whole is cumbrous and necessitates a supporting truck or carriage for its transportation along the trackway as the welding work proceeds. And these defects are inherent in the resistances employed, for the relatively low ratio between the surface area of the resistance material and its volume, has as a necessary incident of this characteristic, a low capacity for radiation of the heat internally generated by the passage of the current therethrough. The resulting slow radiation necessitates heavier material to prevent excessive heating and consequent break-down of the apparatus. Another difficulty with the rheostats in common use is that the resistance elements are so arranged that the heat from one portion increases the heat of another portion above or closely adjacent laterally. Furthermore, in the usual rheostat, the current flows through resistance elements arranged in series and the failure of any element in the series results in breaking the circuit and incidentally causing the failure of the entire apparatus until the break is repaired.

The present rheostat provides an improved device in which these difficulties are practically overcome and an exceedingly light and easily portable apparatus provided. In the form shown, my rheostat comprises an open frame 10 having a series of cross rods 11 of copper or brass tubing extending between the upper frame members and a second series 12 extending between the lower frame members, but staggered with relation to the upper rods. Additional series of rods may be provided where the distance between the upper and lower rods is sufficient to necessitate intermediate support for the resistance wires. These rods are of conducting material and are mounted in the frame in insulating bushings 13, through which they extend—on one side to afford terminals 14 for an associated plug 15 by which, in well understood manner, the resistance may be varied as desired by varying the point of attachment of the wire 16 leading to the welding appliances.

Between the cross rods 11 at opposite ends of the frame, I string a series of fine spiral wires 17 zig-zag up and down, beneath the lower rods 12 and over the upper rods, 11, tying the wires to each rod to hold them in position and insure a good electrical connection therewith. Care must be taken to have the wire evenly distributed between the cross rods and also to secure a certain tension in the spiral to aid in keeping the wires in position. The rods are so spaced apart that the V-shaped angles formed by the zig-zag stringing of the wires, are wide open—with the result that the heat rising from the lower portion of the V does not materially affect the temperature of the upper portion—and at the same time the strands are sufficiently spaced apart laterally and longitudinally (at the narrow portion of the V's) that the lateral radiation from filament to filament does not materially affect the temperatures of the latter.

The number of resistance wires 17 thus strung may be varied, but my thought is to greatly increase the ratio between the radiation area and the volume of resistance material. Consequently the subdivision of the conductors should be carried as far as the mechanical strength of the wire will permit. I have shown ten strands of fine resistance wire in the drawing, but this is of course merely illustrative.

The current passes simultaneously through the several strands in parallel since they are not only interconnected by the cross rods at the ends of the frame but also by the intermediate rods. This interconnection of the strands has the effect of equalizing the distribution of current. And moreover it has the effect of maintaining the rheostat in operative condition, even if some of the strands should break, since the connecting rods form bridges which evenly distribute to the remaining wires the current normally carried by the broken wire. Again, they assure the existence of the same potential between the wires at like points in the lengths of the wires and thus prevents arcing between wires should the latter accidentally come into contact with each other. Furthermore, should the wires at the interior of the rheostat tend to heat more than the marginal wires, and thus introduce additional resistance, the cross rods automatically redistribute the current, thus equalizing the resistance in all the wires.

The total result of the construction indicated is a very high capacity rheostat combined with a very light portable construction.

To control the connection to the rheostat from the source of current, I utilize a switch carried by an insulating plate 18 overlying, in part, the open top of the frame. This switch comprises a blade 19 pivoted on a vertical axis 20, and having a main contact 21 and an auxiliary spring contact 22, coöperating respectively with the main switch terminals 23 and the auxiliary terminal 24. Between the latter and the terminal plate 25 a resistance 26 is provided. On the opening of the switch, the contact 22 parts from terminal 24 before the contact 21 parts from its terminal 23. The resistance 26 reduces the current before the final break and thus tends to minimize danger of an arc forming on the opening of the switch. To further quench the arc, the insulating base 18 is cut away at a point beneath the terminals, so that the upward draft of hot air from the resistance wires 17 tends to blow out any arc that tends to form. This feature of my invention may be utilized with any suitable form of switch and is not limited to the particular switch shown which is *per se* of well known construction.

Handles 27 are provided at opposite ends of the frame to afford ready means for lifting the latter.

Among the advantages of the present construction over rheostats capable of like service now in general use, may be pointed out (1) light weight. My construction weighs but a quarter to a third as much as other rheostats which employ resistance coils, and about one-fortieth as much as one in which resistance grids are used.

(2) Uniform heating of resistance wires. By my arrangement of the wires I avoid an overheated interior or top of the rheostat.

(3) Free, unobstructed and voluminous air supply to every part of the resistance wires.

(4) Maximum ratio between radiation surface and the volume of the resistance material. (5) Strength, durability and ease of repair. (6) Arrangement of switch contacts so that the heat from the resistance aids in quenching any arc that tends to form on the opening of the switch.

Various modifications of detail of construction and arrangement will readily occur to those skilled in the art, which do not depart from what I claim as my invention.

I claim as my invention:—

1. A rheostat resistance element comprising a series of resistance wires strung zigzag without crossing, arranged in substantially vertical, transversely spaced planes and forming V-shaped reaches opening alternately upward and downward, the angle between opposed bends being a predetermined constant, and sufficiently great to prevent the material heating of the upper reaches of the wires by the radiation heat rising from the lower reaches thereof, substantially as described.

2. A rheostat comprising an open frame having staggered upper and lower rows of cross bars of conducting material and a series of fine resistance wires arranged in parallel and engaging said cross bars in zigzag arrangement, the angle between opposed bends of the wires being sufficiently wide

to prevent the material heating of the upper reaches of the wires by the radiation heat rising from the lower reaches thereof.

3. In a rheostat a main switch having its parting terminals arranged above the resistance members and in the path of the heated air column rising from the latter, for the purpose described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses.

JOHN G. KJELLGREN.

Witnesses:
D. S. ARNOLD,
W. VAN NOSTRAN.