NOTE ON A METHOD OF INCREASING THE CARRYING CAPACITY OF A RHEOSTAT

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When using an ordinary slide resistance to control a current it often happens that when the current is the largest, only a small part of the resistance is being used. This may be a disadvantage for two reasons: in the first place the smallest change possible in this small part of the resistance may greatly increase the current and in the second place the resistance may be very much overheated.

A method has been devised whereby it is possible to lessen both these difficulties by using both ends of the rheostat and thereby double its carrying capacity and at the same time make it much easier to control the current.

The working of the rheostat is best explained by a reference to the figure. In Fig. 1 the resistance is shown, by the heavy lines with the two main binding posts of the rheostat at *A* and *B*. In this case the rheostat is made up with sixteen steps. As such a rheostat is ordinarily used, the current enters at *A* passes through

FIG. 1

the resistance *R*, then through some sort of a sliding contact, shown at *C*, and out through the binding post *B*. To increase the current, the sliding contact *C* is moved forward, thus short circuiting one or more turns of the rheostat. With the rheostat shown there are sixteen steps in the variation of the current. For a rheostat where each step is equal, as more and more of the steps are cut out a single step becomes a greater percentage of what

remains. For this reason the current control becomes very poor as the current is increased. There is another disadvantage in such a rheostat and that is this—when the current is increased by cutting out more and more of the resistance there is apt to be too large a current through the part of the resistance being used while a part of the rheostat is not in use at all.

To increase the carrying capacity of such a rheostat the additional sliding contact *D* is added and also another binding post *E* at the opposite end of the rheostat from the binding post *A*. The binding posts *A* and *E* are connected through the switch *K* so that by closing the switch *K* the two ends of the rheostat can be connected.

To operate the rheostat in this form proceed in the ordinary manner (switch *K* open) with the current entering at *A* passing through the resistance *R*, the sliding contact *C* and out at *B*. To increase the current move the sliding contact *C* towards *A* until it has passed over three-fourths of the distance from *E* to *A*, that is, until the resistance being used is one-fourth that of the entire rheostat. Now to obtain a larger current move both sliding contacts *C* and *D* to the center of the rheostat *R* and close the switch *K*. The resistance of the rheostat with switch *K* closed and the sliding contacts in this position is equal to about one-fourth of the total resistance of the rheostat, that is, the resistance will be about the same as before the sliding contact *C* was moved back to the center. The current will divide and one-half will enter at *A* and pass through one end of the rheostat and out through the sliding contact *C* while the other half will enter at *E*, pass through the other end of the rheostat and out through the sliding contact *D*. To increase the current move either the sliding contact *C* towards *A* or move the sliding contact *D* towards *E* or move both the sliding contacts *C* and *D* towards the ends *A* and *E*.

If a better control of the current is wanted, increase the current to about the desired value by moving but one sliding contact and then make the final adjustments by moving the other sliding contact in whatever direction necessary. By this method a very much better control of the current is possible and at the same time the carrying capacity of the rheostat is greatly increased.

Even for a rheostat when the resistance of the steps towards the end becomes less and less this method of use with two sliding contacts is very advantageous. In this case care will have to be taken not to send the same current through the two ends of the rheostat. However a very much better control will be obtained. Two rheostats connected as described above have been in use in this laboratory for the past three or four years and have been very satisfactory. One is a water cooled nichrome-ribbon rheostat intended to carry about forty to fifty amperes. When fitted with two sliding contacts and connected up as described above it will carry about eighty to one hundred amperes and at the same time it is possible to get good adjustment of the current.

It is quite obvious that this method can be carried a step farther by addition of two more sliding contacts and at the same time add a binding post at the center of the rheostat so that the center can be connected through another switch K' to the two ends A and E . In this case when the two sliding contacts C and D are brought to the center of the rheostat the other two sliding contacts G and H are to be moved to the center. The sliding contacts G and H are to be between C and D . To operate move but two of the sliding contacts C and D away from the center until each has passed over three-quarters of the length of that half of the resistance. Now move two sliding contacts to within one quarter of the distance to each end of the rheostat and close the switch K' . The resistance being used will be about the same as it was when the two sliding contacts were each within one-eighth of the distance from each end. To further increase the current move C and D towards opposite ends of the rheostat or move G and H towards the center. Since each sliding contact can be moved alone or in connection with any one or more of the others, it can be seen that this method with four sliding contacts will give a very good control.

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