



## UNITED STATES PATENT OFFICE

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## SHUNT

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My invention relates to shunts for electrical circuits and more particularly to heavy-capacity, high-accuracy shunts used in connection with electrical measuring instruments.

5 In a heavy-capacity shunt, the current has a tendency to distribute itself unequally in its terminal blocks because of the different magnitudes of resistance existing between the various contact surfaces formed by the bus bars or cable lugs and such terminal-blocks. This unequal distribution of current in the terminal blocks of a shunt causes a variation in the potential between the instrument-lead contact points which results in an error in the indication of the measuring instrument.

Also, it is difficult, because of this variation of potential between the ammeter-lead contact points, to accurately duplicate the contact and distribution conditions in calibrating the shunt, as they exist in actual service.

My invention has for an object to provide means whereby the unequal distribution of current in the shunt terminal blocks is equalized.

25 Another object of my invention is to provide means for obtaining the average potential of a plurality of points of different potential in the terminals of an ammeter shunt.

A further object of my invention is to provide means for accurately measuring heavy electrical currents.

In practicing my invention, I provide, in conjunction with a heavy-capacity shunt and an electrical instrument for association therewith, means for electrically connecting said instrument to the terminal blocks of said shunt in such manner that the voltage drop across the shunt is the average of the drops between a plurality of points on the shunt terminal-blocks. Errors usually resulting from unequal current distribution in the shunt terminals are accordingly avoided; and, when a shunt has once been calibrated, it may be installed for service and the accuracy thereof will not be adversely affected by the contact and distribution conditions there obtaining.

My invention is illustrated in the accompanying drawings, in which:

50 Fig. 1 is a view, in elevation, of a shunt

constructed in accordance with my invention, and

Fig. 2 is a view, in perspective, of a shunt of the type shown in Fig. 1 having an electrical measuring instrument operatively associated therewith.

The shunt 2 comprises two terminal blocks 3 and 4 between which extend a plurality of parallel resistance bars or conductors 5, the ends of which are fabricated by solder or welded to the faces of the terminal blocks, 3 and 4. The bars or sheets 5 are separated from each other by air spaces to permit ventilation, in accordance with the usual practice.

The outer ends of the terminal blocks 3 and 4 are provided with parallel slots 6 to receive busbar conductors 7. The bus-bars are clamped to, or otherwise intimately associated with, the terminal blocks 3 and 4 so that current may be readily conducted from the one to the other.

The values of contact-resistance, however, between the several bus-bars 7 and the terminal blocks 3 and 4 may and do vary considerably because of variations in pressure and contact area. The current in the shunt is, therefore unequally distributed in the terminal blocks 3 and 4, and, if only a single contact on each terminal block is employed for the leads to the measuring instrument, which has been the custom prior to my invention, an erroneous measurement may result because the voltage of the particular contact point selected may differ from that of other points on the terminal block and may be high or low, depending upon the paths taken by the current through the terminal block.

I avoid the above mentioned probability of error by providing a plurality of contact points 8 on the upper and lower surfaces 9 and 10 of each terminal block and by connecting each of these contact points 8, by means of a separate conductor 12, to terminals 13 of a measuring instrument, such as a millivoltmeter 14.

The ends of the conductors 12 are secured to the contact points 8 by means of screws 15 that fit suitably threaded holes in the terminal blocks. The conductors 12 are also

preferably covered by an insulating material to permit the grouping of them into conduits 16, thereby constituting multi-conductor leads, for connection to the terminals of the instrument 14.

By selecting a plurality of contact points 8 on the terminal blocks, as outlined above, the voltage drops between these points are averaged, and the instrument 14 is energized independently of the current distribution in the terminal blocks.

The conducting leads 12 are preferably high in resistance, as compared with the resistance of the shunt, as has been customary in the prior practice, but are lower in resistance than the internal resistance of the instrument 14.

The milli-voltmeter 14 is preferably calibrated separately, with all of the leads 12 in place and properly paralleled so that all errors are taken care of up to the contact points 8.

By use of my invention, more accurate measurements may be made of the true current passing through a shunt than have heretofore been made, insofar as I am aware, because the true average value of potential of each terminal block is impressed on the terminals of the instrument.

While I have shown only one embodiment of my invention, in the appended drawings, I do not wish to be limited thereby, but desire that only such limitations shall be imposed upon my invention as are expressed in the appended claims.

I claim as my invention:

1. A shunt for use in conjunction with instruments of the millivoltmeter type embodying a shunt portion of known resistance, terminal blocks secured to the ends thereof, and a plurality of terminals distributed over the area of each block to respectively receive a plurality of leads from the instrument.

2. An instrument shunt having terminal blocks secured thereto, said terminal blocks embodying means for connecting said shunt in an electric circuit and each terminal block having a plurality of spaced means for electrically connecting a plurality of leads from an electrical instrument thereto.

3. A shunt comprising terminal blocks and resistance means connecting said terminal blocks, and means for electrically connecting an instrument to a plurality of spaced points on the surfaces of said terminal blocks.

4. A shunt comprising terminal blocks and resistance means connecting said terminal blocks, and means including electrical conductors having a high resistance, as compared with the resistance of said terminal blocks, for connecting a plurality of separate, spaced points on said terminal blocks to the terminals of an instrument.

5. A shunt comprising terminal blocks and resistance means connecting said terminal

blocks, each of said terminal blocks having a plurality of contact points symmetrically disposed on the respective surfaces thereof, whereby the average difference of potential between said blocks may be impressed upon the terminals of an instrument.

6. A shunt comprising terminals, resistance means connecting the same and means for connecting a translating device to the shunt including a single lead including a plurality of branch leads connected to one of said terminals at a plurality of spaced positions.

7. A shunt and means for affecting a translating device in accordance with an average effect thereof including a plurality of leads each embodying a plurality of branch leads associated with the shunt at spaced positions.

8. A shunt embodying main terminals each including a plurality of tap terminals spaced symmetrically and laterally to the longitudinal axis of the shunt, the tap terminals of each main terminal being for connection to a plurality of branches of a common lead.

9. A shunt embodying main terminals each including a plurality of sets of tap terminals spaced symmetrically and laterally to the longitudinal axis of the shunt, the tap terminal sets of each main terminal being connected to opposite surfaces thereof and the taps of the sets in each of the main terminals being connected to a common instrument lead.

10. A shunt embodying main terminals each including oppositely-disposed parallel-plane surfaces and a set of laterally-spaced tap terminals on each of said surfaces, the tap terminals of each main terminal being for connection to a common instrument lead.

In testimony whereof, I have hereunto subscribed my name this 26th day of April 1929.

PAUL MacGAHAN.