No. 859,255. PATENTED JULY 9, 1907.

F. W. ROLLER.

SHUNT FOR ELECTRICAL MEASURING INSTRUMENTS.

APPLICATION FILED JAN. 13, 1905.

Fig. 1

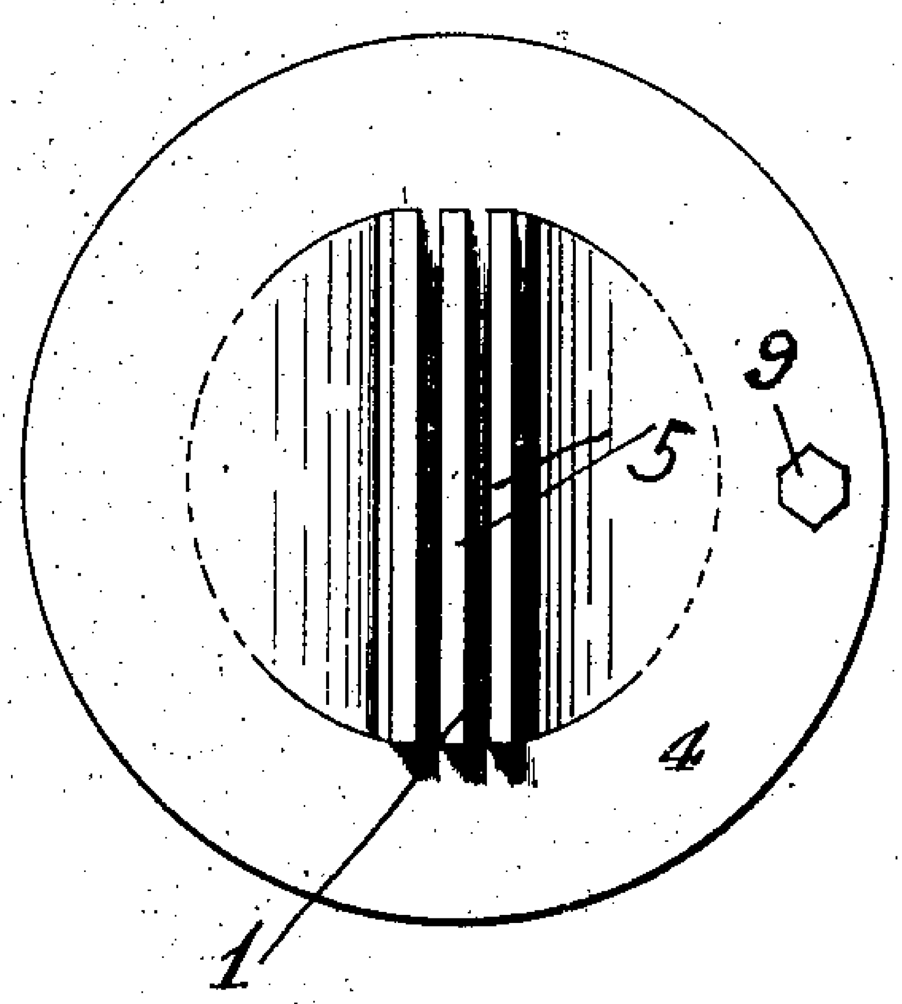
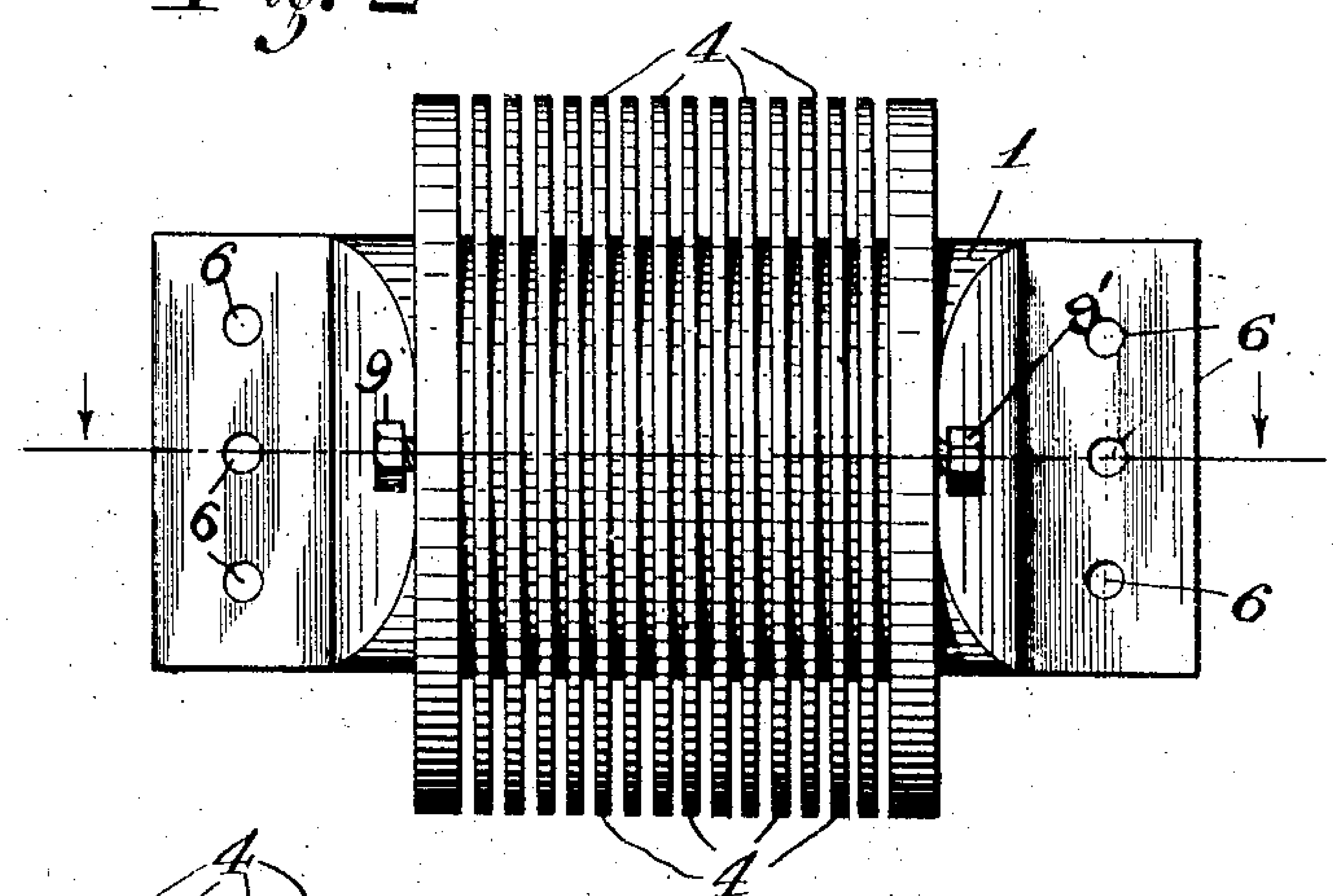


Fig. 2



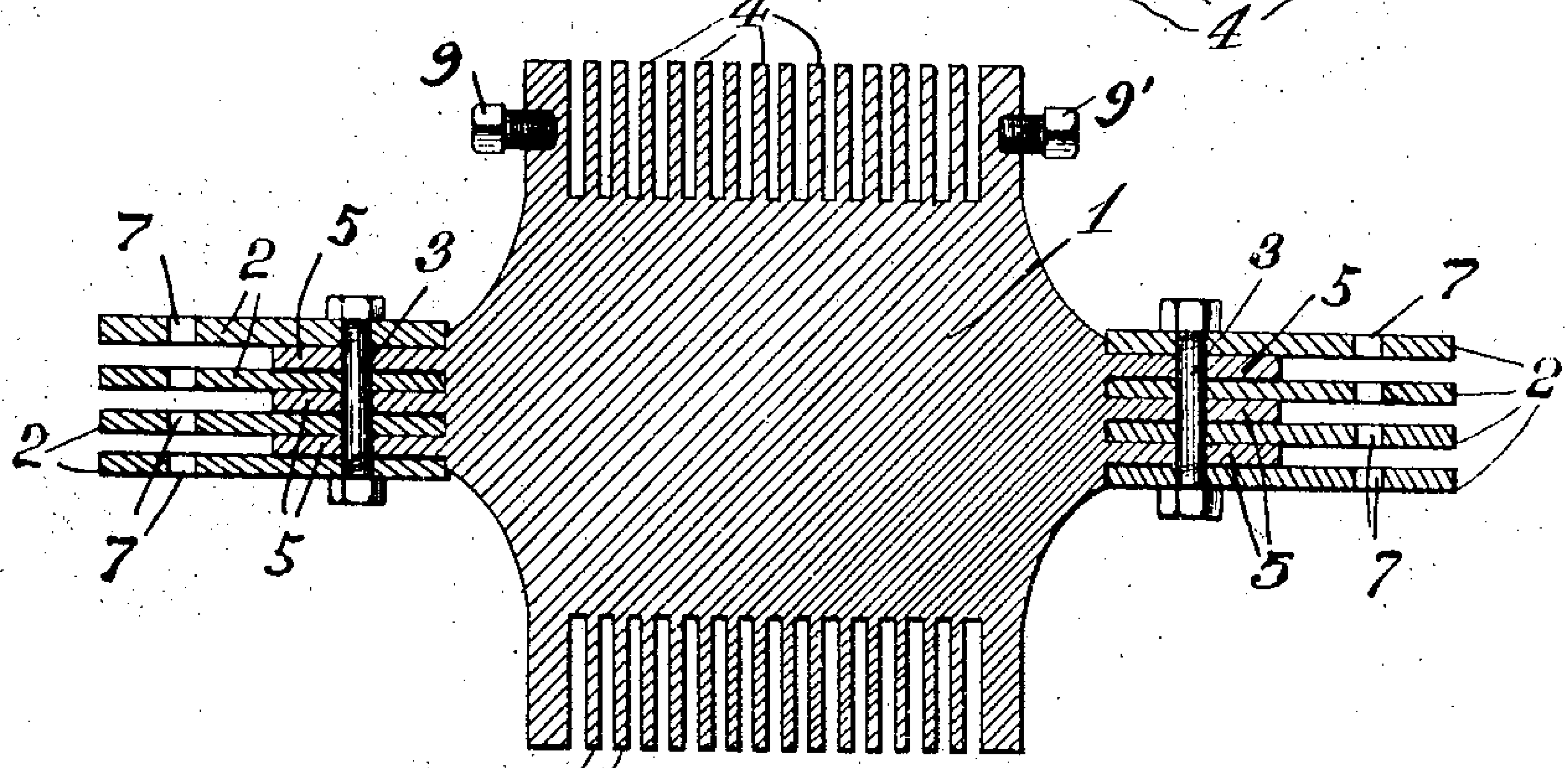


Fig. 3

Fig. 4

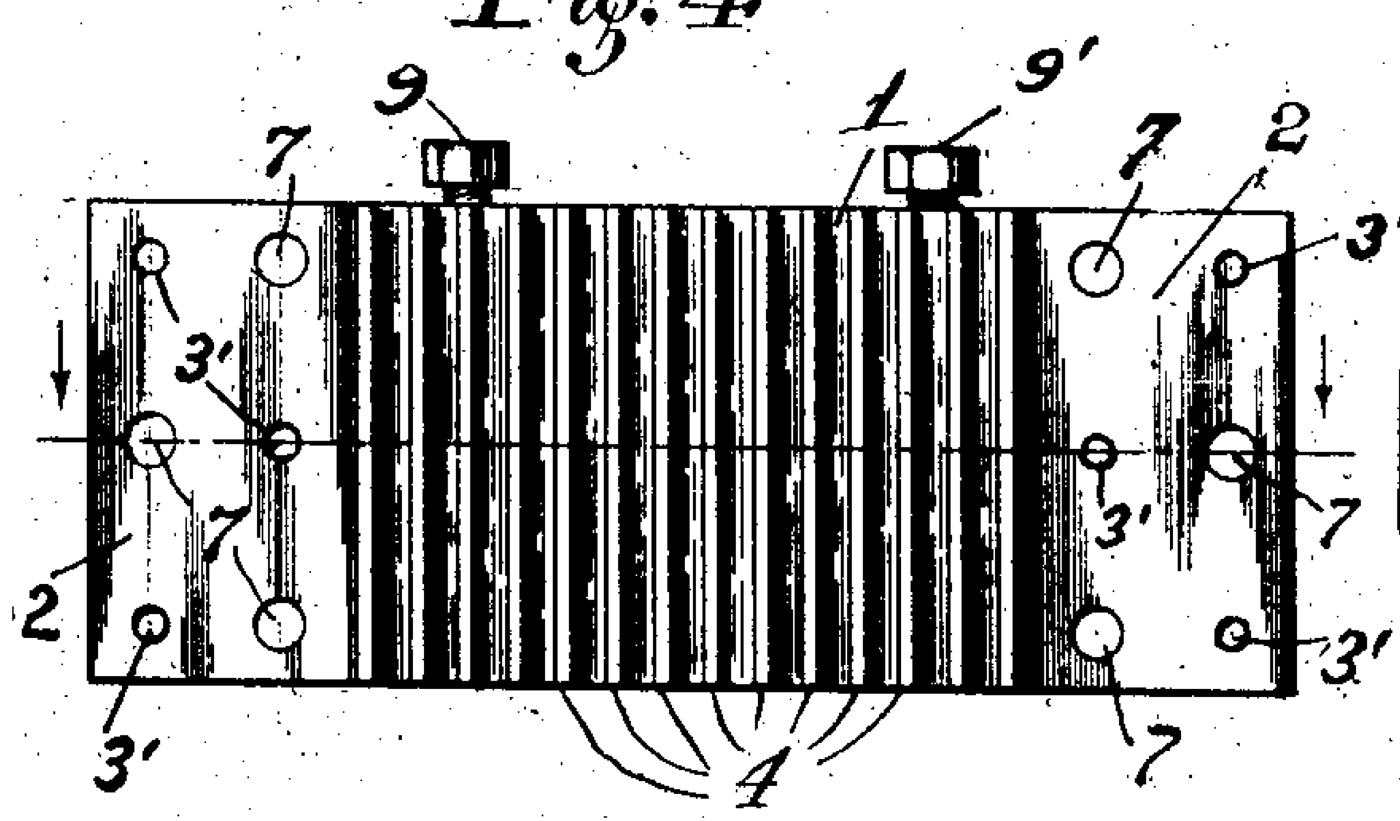
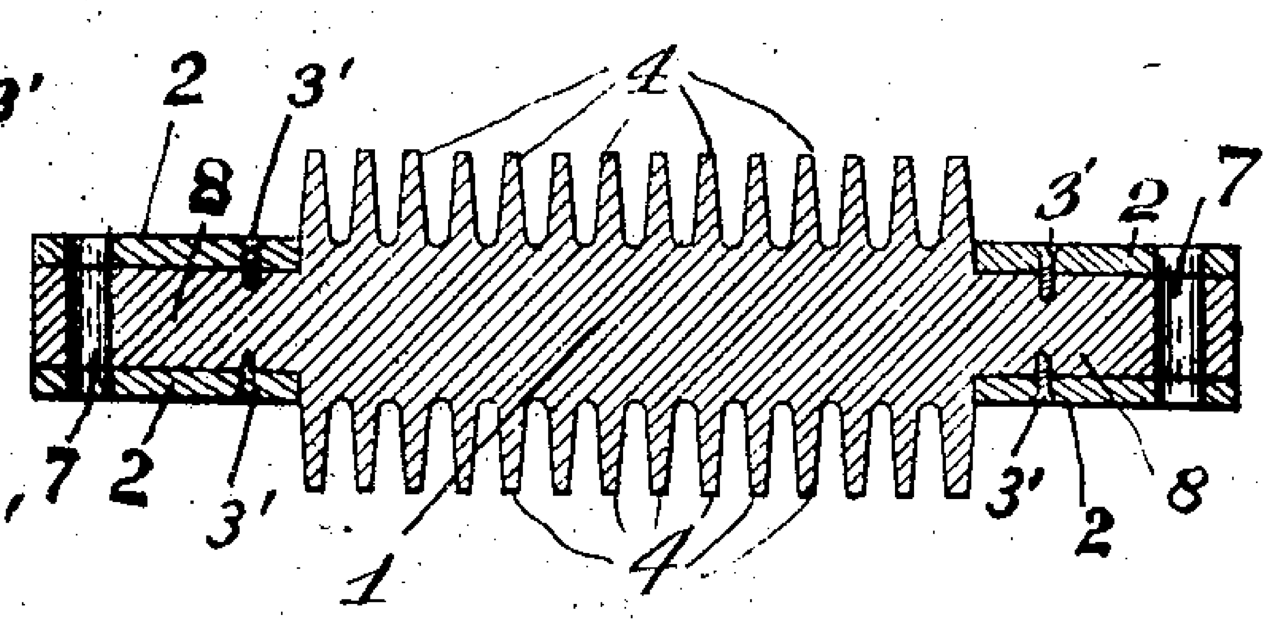


Fig. 5



Witnesses
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UNITED STATES PATENT OFFICE.

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SHUNT FOR ELECTRICAL MEASURING INSTRUMENTS.

No. 859,255. **Specification of Letters Patent.** **Patented July 9, 1907.**

Application filed January 13, 1905. Serial No. 240,912.

To all whom it may concern:

Be it known that I, FRANK W. ROLLER, a citizen of the United States, residing at Plainfield, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Shunts for Electrical Measuring Instruments, of which the following is a full, clear, and exact specification.

In systems of electrical measurement as now practiced it is a common practice to measure current by a sensitive instrument which is so related to the circuit as to carry only a small fraction of the current passing, the larger fraction of the current passing through a shunt of relatively large carrying capacity. Such shunts, when intended for use on switchboards, should preferably be compact, to save space and weight, and when used for portable purposes, the same reasons require a compact construction. Inasmuch as shunts necessarily have resistance, the current flowing therethrough generates heat which must be dissipated in order that there may not be a temporary rise sufficient to make erroneous the indications of the instrument used in connection therewith, or to cause deterioration or complete destruction of the shunt itself. It has heretofore been common practice to employ some means for cooling the shunt strip or strips, and this has usually been effected by subdividing the strip into a number of separate laminæ, each separately soldered at each end to a terminal by which connections with the bus-bar or main conductors may be made. In order to accentuate the cooling, massive terminals have been provided for the shunt strip or strips of such capacity as to readily withdraw the heat from the shunt-strips, and thereby keep them at as nearly uniform a temperature as possible. I have found that a single shunt strip may be used having many times the cross section of those commonly used and a large drop of potential may be maintained and the strip kept at a uniform and sufficiently low temperature throughout the whole of its length by employing a plurality of distributed metallic radiators fixed in good heat-conductive relation to the resistance strip. A shunt of this construction will have a minimum size for a definite capacity and will dissipate the heat in such a way as to produce a required difference of potential between its terminals without undue rise in temperature. This form of shunt is I believe entirely new, and has many important advantages which will be hereinafter more fully set forth. My invention is therefore characterized by a substantial cross section of resistance strip and a cooling agent so related thereto that a high current density may be maintained continuously.

In the accompanying drawings, I have shown a shunt embodying my invention.

Figures 1 and 2 are respectively end and plan elevations. Fig. 3 is a section of the shunt shown in Fig. 2 with terminal plates added thereto, and Figs. 4 and 5 are respectively plan and sectional views of a modified form.

1 represents a resistance body or strip which may be of any of the metals commonly used for that purpose by those skilled in the art, such, for example, as copper, iron, German silver, manganin, etc. The resistance body in the form shown in Figs. 1 to 3 is provided with projections 5, between which and about which are added stiff plates 2. These are shown bolted to the resistance portion by bolts 3, which pass through holes 6 of projections 5. The point between the resistance portion and plates 2 should be strong and the plates may sometimes be soldered, or first amalgamated with a flexible amalgam and then through bolted, so as to maintain a good electrical contact relation between the two. By making the plates 2 of the same metal as the conductor to which they are to be connected, such as copper for the copper bus-bars of a switchboard, a good electrical contact may be made with the bus-bars simply by placing the strips 2 between and about the bars and bolting the parts together as by a bolt passing through the holes 7. It is not absolutely essential that the resistance portion be provided with terminal strips, as the resistance may sometimes be secured directly to the bus-bar strips or main conductor. In the form shown in Figs. 4 and 5 I have shown the body of the resistance portion provided with a single projection 8 at each end. These projections are faced by strips 2 which are secured firmly to the projection 8 as by the screws or bolts 3′, and with flexible amalgam between the parts to secure good electrical contact, or the parts may be soldered. The plates 2 will ordinarily be made of copper and so easily secure good electrical contact with the external copper conductor or conductors which will be clamped to the said plates by bolts passing through the holes 7. As above stated the plates 2 are not essential for easily securing good electrical contact with the outside conductor, and good contact with the outside conductors may sometimes be secured without the use of these strips. The bolts or screws 9, 9′ are shown for the connection of the flexible leads from the indicating instrument, the said instrument being subjected to the difference in potential between the points of connection at 9, 9′ and therefore indicating the strength of current passing through the shunt. Arranged transversely on the resistance strip or bar are a number of radiators 4, 4, 4, etc., distributed at short intervals along its length and mounted in any way to effect a good thermal relation. These may be integral therewith or held thereto in any other well understood manner which will maintain them in a fixed position. In Figs. 1 to 3 the resistance body is cylindrical and has the radiators 4 entirely encircling the body por-

tion. In Figs. 4 and 5 the body portion is rectangular in cross section and the radiators 4 are formed only on two sides of the shunt. It will be seen that in my type of shunt, I do not rely upon the terminals or bus-bars to carry away and dissipate the heat, but provide means within the limits of the shunt strip itself to effect this result, and by reason of such construction I am not necessarily confined to metals having high specific resistance.

While I employ a large radiating surface it will be seen that I do not do so by increase of length and breadth of the strip itself, and, therefore, I can make my shunt very compact and yet of large capacity.

I prefer to mount the radiators or vanes in a vertical position, so as to take advantage of the cooling effect of convective air-currents, and I make these vanes of varying depth, according to the desired carrying capacity of the shunt.

While I have shown the radiators in the form of flat washers or flanges, various other forms may be employed with more or less advantage, and it will be understood that wherever I have used the term "flanges" in this specification and in the appended claims, it is intended to include any equivalent thereof, such as solid pins, threaded pins, or other radiating projections.

The feature described of making the shunt bar or strip of a single piece is of considerable advantage. It makes a stronger structure and requires a minimum number of soldered joints, and this permits the employment for the resistance material of desirable alloys which are difficult to solder. With a single strip, as in my shunt, the joint can be examined and treated easily on all sides and can, therefore, be made thorough and reliable; but with several joints close together, as in constructions with separated laminæ, this becomes impracticable. The size of the bar will vary, of course, according to the specific resistance of the material employed for the resistance body. The proportions and material of the various parts will also vary according to the results which it is desired to attain in accordance with principles well known in the art.

There is no limit upon the length of the resistance strip I may employ, since the tendency to increased heat by reason of increase of length is overcome by providing proportional increase of surface, and consequently in the power of the radiators to abstract heat. This is not true of types of shunts in which the cooling is chiefly maintained by the effect of the bus-bars and terminals, for in shunts constructed on this plan the length of the resistance strips must of necessity be reasonably short or they will heat unduly in the center. For cases where a large drop of potential is required, therefore, my construction is peculiarly serviceable, as the drop of potential can be increased by increasing only the length of the resistance bar or plate and the number and surface of the radiators.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. A shunt for electrical measuring instruments, comprising a resistance-strip having heat-radiators in good thermal relation at distributed points throughout its surface.

2. An electric shunt comprising a strip of metal having a small temperature coefficient and transverse metal heat-radiators distributed over its surface in good thermal relation to the strips.

3. An electric shunt comprising a metal bar studded with metal radiators, and terminals for connecting with bus-bars.

4. A measuring-instrument shunt consisting of a resistance-body of low temperature coefficient provided with transverse metal radiators at distributed points and in good thermal relation to the resistance-body.

5. A measuring instrument shunt consisting of a resistance body of low temperature coefficient, and a plurality of transverse metal radiators thereon in good thermal relation thereto, said body having a large joint area for connection with the main circuit.

6. An electric shunt consisting of a bar of metal of high resistivity and low temperature coefficient having terminals of low-resistance metal, said bar being in good thermal relation throughout its extent to a heat conductive and diffusing agent.

7. A shunt for electrical measuring instruments having a resistance strip larger in cross section than the terminals.

8. A shunt for electrical measuring instruments comprising a resistance strip larger in cross section than the terminals and having radiating flanges on said strip.

In testimony whereof I affix my signature, in presence of two witnesses.

FRANK W. ROLLER.

Witnesses:
C. V. Edwards,
Geo. A. Hoffman.