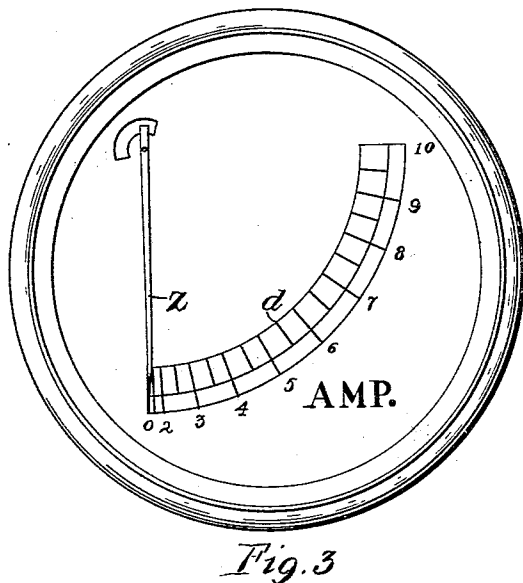
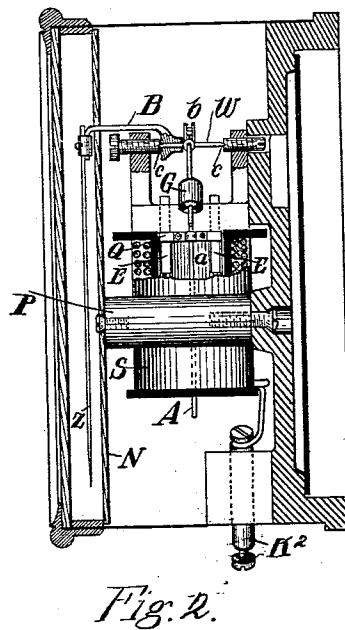
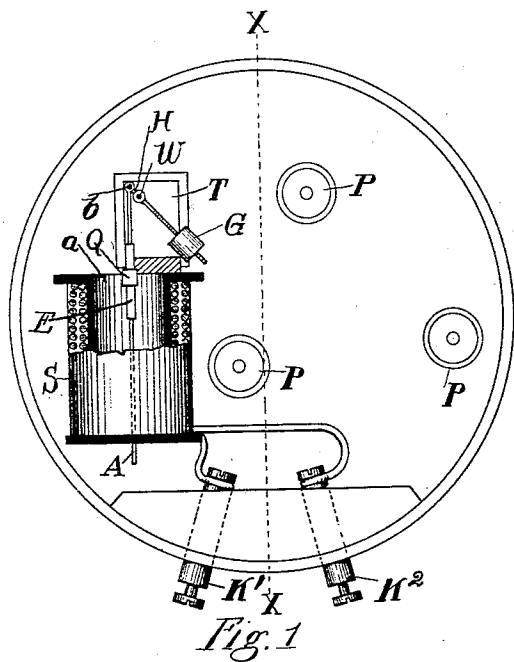


(No Model.)

F. VON HEFNER-ALTENECK & H. GÖRGES.
ELECTRICAL MEASURING INSTRUMENT.

No. 555,286.

Patented Feb. 25, 1896.



Witnesses:

De Witt C. Thayer,
W. Clyde Jones.

Inventors:
Friedrich von Hefner-Alteneck
Hans Görges.
By Barton & Brown
Attorneys.

UNITED STATES PATENT OFFICE.

FRIEDRICH VON HEFNER-ALTENECK AND HANS GÖRGES, OF BERLIN, GERMANY, ASSIGNORS TO THE SIEMENS & HALSKE ELECTRIC COMPANY OF AMERICA, OF CHICAGO, ILLINOIS.

ELECTRICAL MEASURING-INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 555,286, dated February 25, 1896.

Application filed November 25, 1895. Serial No. 570,063. (No model.)

To all whom it may concern:

Be it known that we, FRIEDRICH VON HEFNER-ALTENECK, a subject of the King of Bavaria, and HANS GÖRGES, a subject of the King of Prussia, German Emperor, residing at Berlin, in the Kingdom of Prussia and German Empire, have invented certain new and useful Improvements in Electrical Measuring-Instruments; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to electrical measuring-instruments, and its object is to secure a reliable instrument which is adapted to the purposes of an ampère-meter, or, with proper change of winding, to the purposes of a voltmeter, which is at the same time accurate and easily calibrated, and which is adjustable in the way hereinafter indicated.

The construction of the meter will be understood from the accompanying drawings, in which—

Figure 1 represents a front elevation of the instrument with the face and indicating-hand removed and partly in section. Fig. 2 is a sectional view upon the line X X of Fig. 1. Fig. 3 represents a front elevation of the complete instrument.

Like letters of reference are used to indicate similar parts in the different views.

The solenoid S is provided with an interior cylindrical space *a*, in which is hung the wire-support A, preferably of non-magnetic metallic material. The lever H is fulcrumed upon a trunnion at W and carries the adjustable weight G. Upon the other end of the lever at *b* the support A is suspended in any suitable way to permit the lever H to rock upon the fulcrum W when the support A is drawn in a downward direction. Upon the support A the magnetic bars E E are fixed by a cross-piece Q, which may be arranged so that the position of the bars or rods E E can be adjusted in a vertical direction. The rods E E are of such thickness that they will be magnetized to saturation by the weakest current to be measured and are situated at a distance apart slightly less than the internal

diameter of the solenoid to bring the rods near to the coils of the solenoid. The fulcrum W is constructed of the trunnion mounted in the adjustable bearings *c c*, so that it will turn readily. The axis upon which the rods E E are mounted is parallel to a plane extending through the rods of iron in such a way that the said plane does not coincide with the axis of the solenoid, but is disposed eccentrically, the eccentricity varying as the rods are drawn into the solenoid. When the balance has moved half-way over its total range, the center of the solenoid coincides with the plane through the two rods of iron. Upon this shaft is mounted the bracket B, which projects forward through the face N, and to which is attached in any suitable way the pointer Z. The face N is preferably composed of a non-magnetic sheet of metal bearing the scale *d* and is supported upon the three pillars P P P. The weight G is so adjusted that when no current is passing through the solenoid the pointer Z indicates zero upon the scale. The frame T serves as a support to the solenoid, and the binding-posts K¹ K², connected to the terminals of the solenoid, are adapted to connect the same in circuit.

It will be readily understood that this device is adapted for the purposes of either a voltmeter or an ampère-meter by making the windings of the solenoid S appropriate to the purposes for which the instrument is intended.

When used as a voltmeter we preferably connect a nickel resistance in series with the solenoid. The instrument is adapted to be used either for direct or for alternating currents.

From the foregoing description it will not be difficult to understand the operation of our invention.

Upon the passage of current through the solenoid the iron bars E E are drawn downwardly and operating upon the short end of the lever H cause this lever to rock upon the trunnion W, which carries the hand Z over the scale of the instrument, the distance which the pointer moves being controlled by the strength or voltage of the current passing through the solenoid when the instrument is

used either as an ammeter or a voltmeter. The device admits of ready adjustment to meet the requirements for which it is designed to be used in any given case.

5 Ammeters are required to indicate currents from zero to a certain maximum with great exactness and uniformity. It is desirable, therefore, when used as an ammeter, to have the scale divided as uniformly as possible
10 from the highest to the lowest indications. Now the excursion of the bars E E will vary according to their position with relation to the center of the solenoid, and to secure a uniform swing of the needle for a uniform increase of
15 current the bars E E should be suspended deeply in the solenoid when no current is on or when the hand points to zero. On the other hand, voltmeters usually in practice are required to indicate only slight changes in the
20 voltage, and it is desirable to have the divisions of the scale as wide as possible in those parts which indicate the voltage in the vicinity of which the changes which are to be noted occur. This may be obtained by having the
25 bars extend very slightly into the interior space of the solenoid and arranging the scale with narrow divisions for the lower indications of voltage. At the point where the indications represent the voltages to be observed
30 in practical use the divisions may be made wider.

The instrument is calibrated by comparison with a standard instrument in the usual and well-known way.

35 The precise details of construction which we have made use of in practical instruments are shown and described herein; but it is obvious that many modifications of these details of construction may be adopted without departing from the spirit of our invention. We
40 therefore do not wish to be restricted to the exact construction shown herein; but

What we claim as new, and desire to secure by Letters Patent, is—

45 1. In an instrument for measuring the strength of an electrical current, the combination with a solenoid adapted to be traversed by said current, of two rods of iron of such thickness that they will be magnetized to saturation by the weakest current to be measured,
50 said rods being disposed as near as possible to the coils of the solenoid, a balance upon one end of which said rods are hung, the other end of said balance being suitably weighted,
55 and means for indicating the position of the balance; substantially as described.

2. In an instrument for measuring the strength of an electrical current, the combination with a stationary solenoid adapted to be traversed by said current, of two rods of iron
60 subjected to the attraction of said solenoid, said rods being placed within the hollow of said solenoid as near as possible to its coils and being of such length that parts thereof will project from said solenoid, a suitably-
65 weighted balance upon one arm of which said rods are hung, and means for indicating the position of said balance; substantially as described.

3. In an instrument for measuring the strength of an electrical current, the combination with a solenoid adapted to be traversed by said current, of two rods of iron fastened on a frame parallel to each other and at such a distance apart as to bring them into close
70 proximity to the coils of said solenoid, a balance on which said rods are hung, said balance being pivoted on an axis parallel to a plane extending through said rods of iron in such a way that the said plane does not co-
75 incide with the axis of the solenoid, but is disposed eccentrically, the eccentricity varying according as the rods are drawn into the solenoid; substantially as described.

4. In an instrument for measuring the strength of an electrical current, the combination with a solenoid adapted to be traversed by said current, of two rods of iron mounted on a frame parallel to each other and at a distance from each other slightly less than the
80 inner diameter of the solenoid, said iron rods being of such length and thickness that they will be magnetized to saturation by the weakest current to be measured and being of such length that they will not project beyond the
85 ends of the solenoid, a balance on one arm of which said rods are hung, said balance swinging on an axis parallel to the plane extending through the two rods of iron and disposed so that the center of the solenoid coincides with
90 said plane when the balance has moved half-way over its total range, and means for indicating the position of the balance; substantially as described.

In testimony whereof we have affixed our
signatures in the presence of two witnesses.

FRIEDRICH VON HEFNER-ALTENECK.
HANS GÖRGES.

Witnesses:

EMIL KOLLING,
MAR WAGNER.