(No Model.) 2 Sheets—Sheet 1.

E. W. JEWELL.

COMBINED AMMETER AND VOLTMETER.

No. 510,177. Patented Dec. 5, 1893.

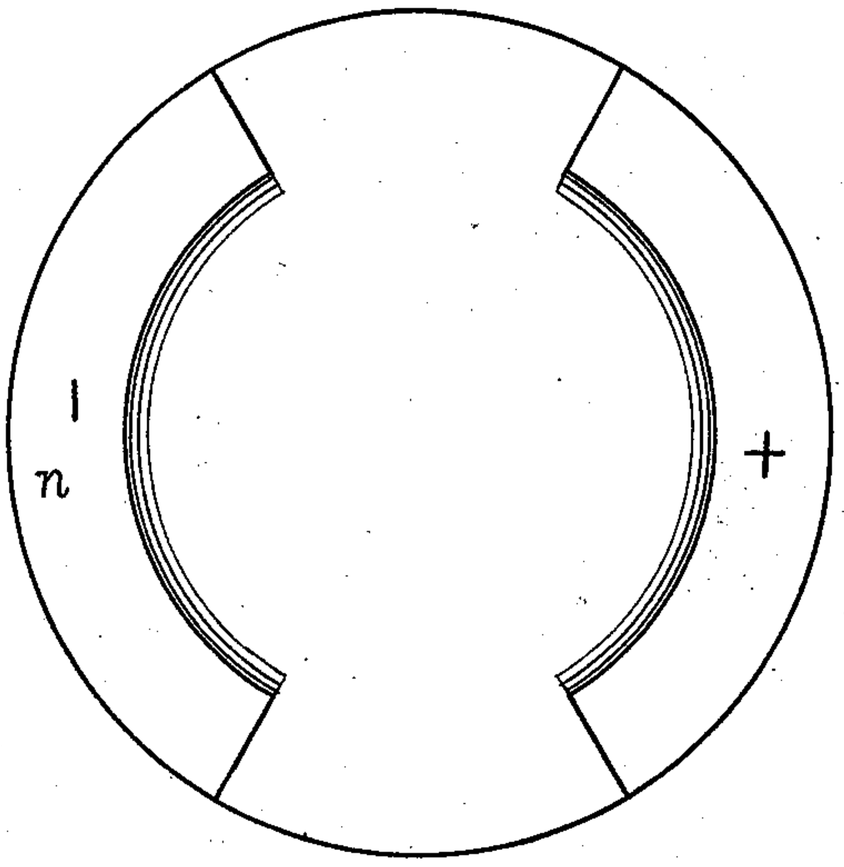

Fig. 2

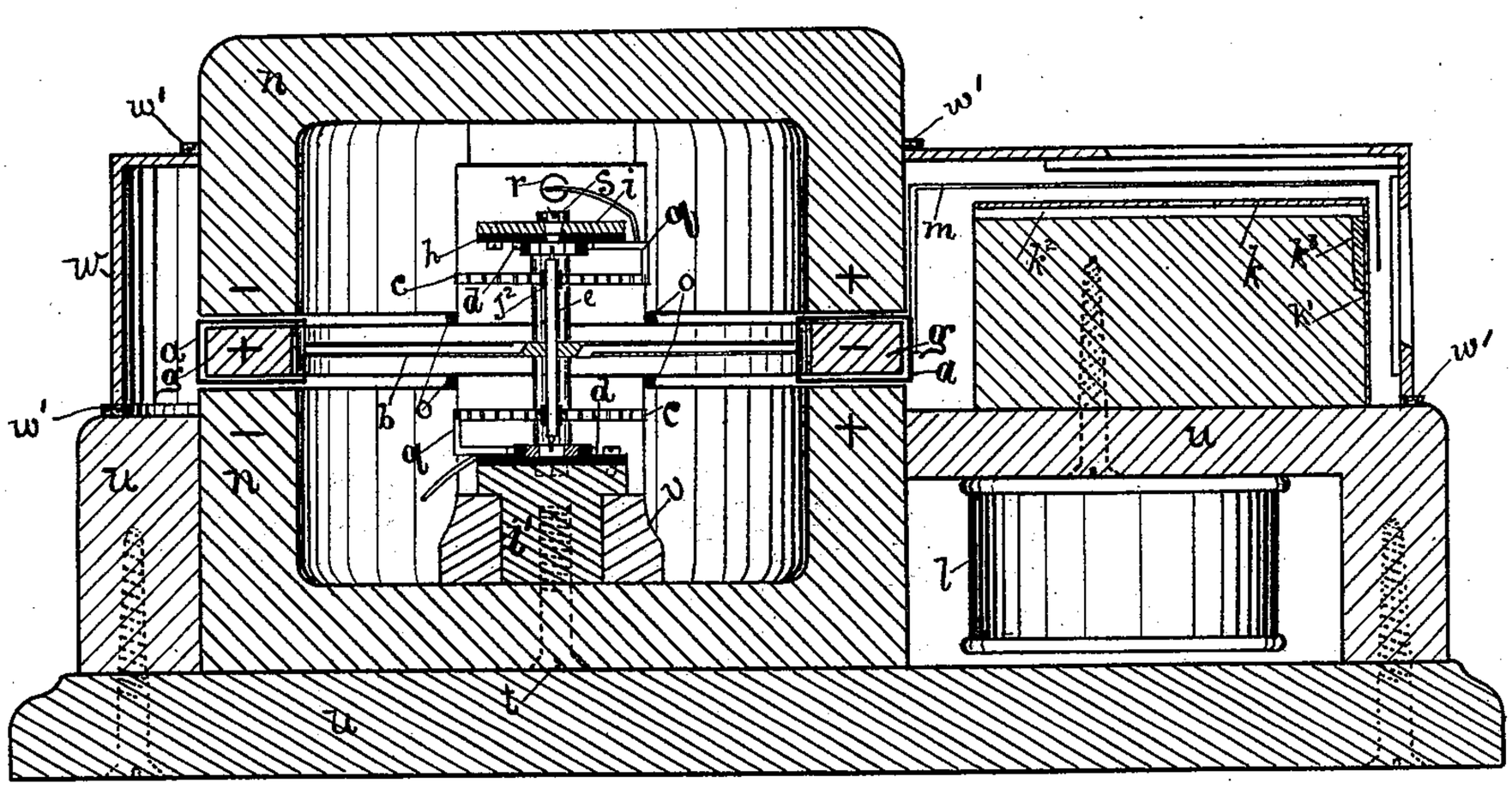

Fig 1.

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(No Model.) 2 Sheets—Sheet 2.

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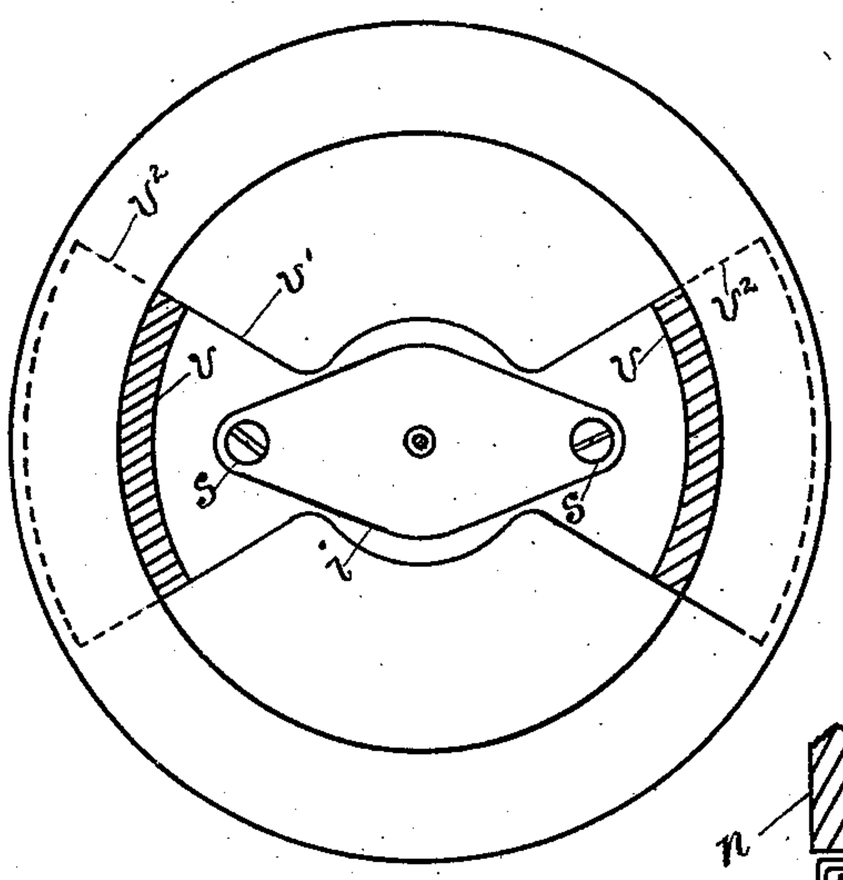


Fig 4.

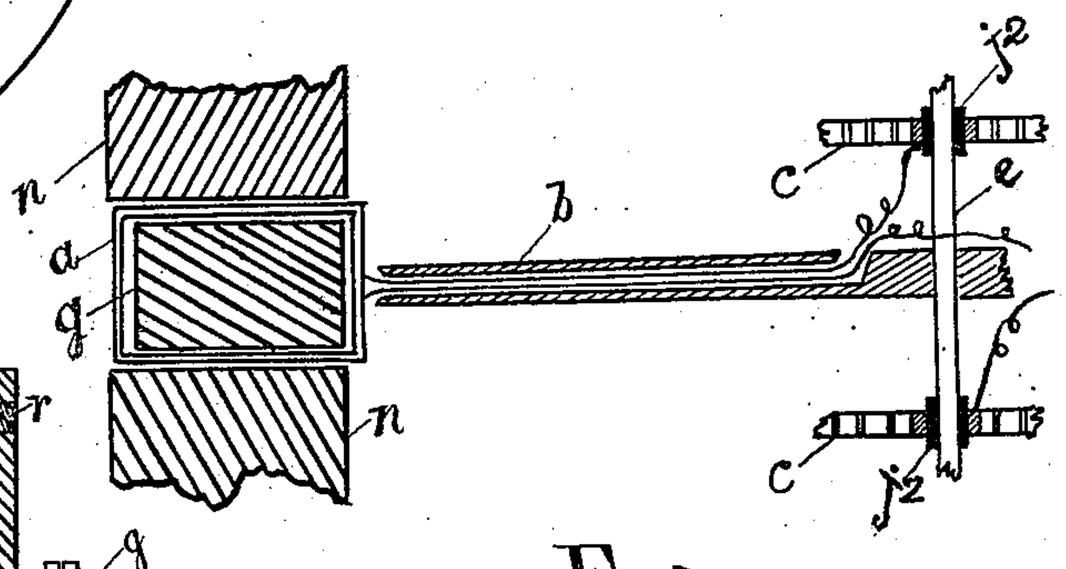


Fig 5.

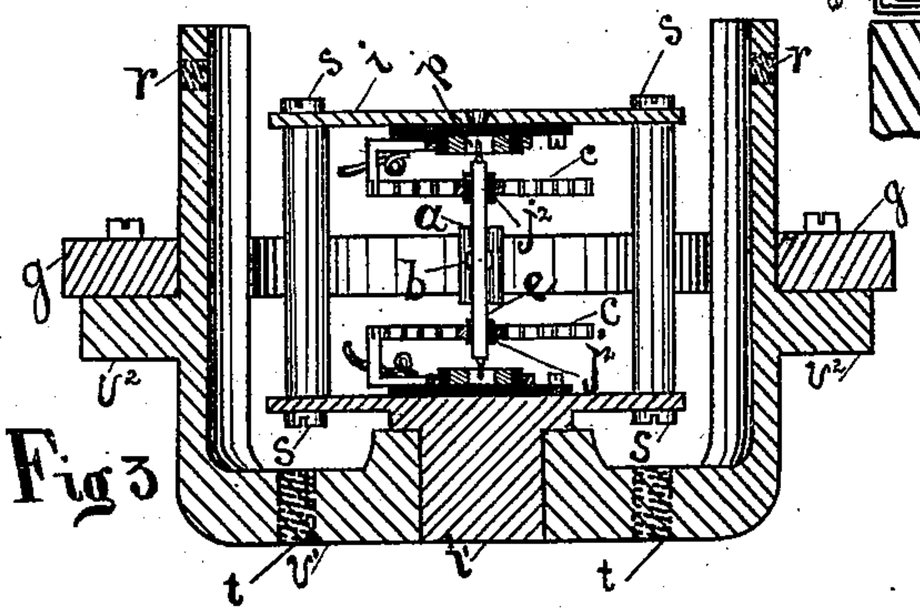
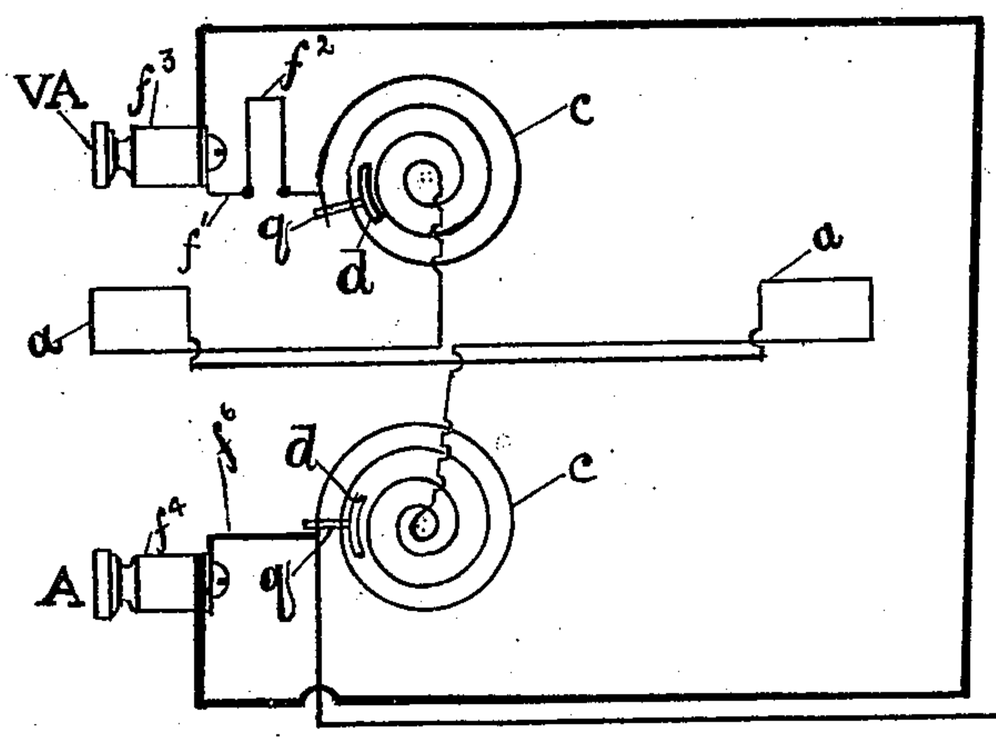


Fig 3



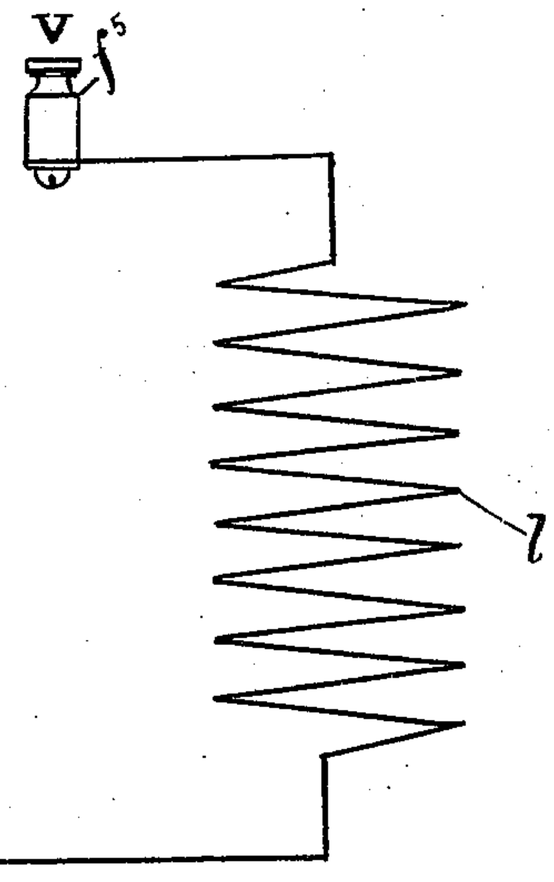


Fig 6.

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EDWARD W. JEWELL, OF WHEATON, ILLINOIS.

COMBINED AMMETER AND VOLTMETER.

SPECIFICATION forming part of Letters Patent No. 510,177, dated December 5, 1893.

Application filed July 1, 1893. Serial No. 479,339. (No model.)

To all whom it may concern:

Be it known that I, EDWARD W. JEWELL, a citizen of the United States, residing at Wheaton, in the county of Du Page and State of Illinois, have invented certain new and useful Improvements in a Combined Ammeter and Voltmeter, which are fully set forth in the following specification, reference being had to the accompanying drawings, forming a part hereof, and in which—

Figure 1 shows a central vertical longitudinal section of my said combined ammeter and voltmeter. Fig. 2 shows one of the magnets as seen on the inside, or under side of the bell. Fig. 3 shows a transverse central vertical section taken at right-angles to the plane which cuts Fig. 1, but showing only the mechanism inside of the bell magnets and a section of the ring armature outside of, and carried, by it. Fig. 4 shows Fig. 3 in plan view. Fig. 5 shows, in vertical section, on an enlarged scale, fragments of the left hand poles, and armature, as the instrument stands relative to the observer, with its surrounding coil and ends of its wire, one connected to the helical spring and the other going to the opposite coil, said springs, the shaft and arm being, also, shown in section. Fig. 6 shows in diagrammatic form the construction of the instrument in its dual capacity.

Like letters of reference refer to like parts.

The object of my invention is to produce an ammeter which may readily be converted into a voltmeter, be conveniently and safely portable, easily set up, and uninfluenced in any magnetic field in any position in which it may, relatively, be placed, wherein the magnetic resistance is reduced to a minimum and, practically, uniform condition and the field is of constant strength throughout the entire travel of the moving coil and the stability of the permanent magnets increased to a maximum degree and thereby the calibration of the instrument made constant; wherein all portions of the moving coil so cut lines of force as to leave no dead wire, thus reducing its necessary weight and inertia effect to the smallest quantity attainable and making its action, practically, dead beat and more sensitive than any instrument of its class heretofore produced, and provided with like-reading horizontal and vertical scales, a fuse as a safety device, and other advantages, as hereinafter set forth. To attain said desirable ends I construct my said new and improved instrument in substantially the following manner, namely:

Two permanent bell-magnets, *n*, *n*, are placed in the same axial line with their like poles facing each other, between which is held an annular soft iron armature, *g*, leaving between it and those poles, air-spaces of about one thirty second of an inch, more or less, for coils, or loops, *a*, *a*, to move, freely, therein. Said coils are secured to the ends of tubular aluminum arms, *b*, *b*, on the shaft, or staff, *e*, stepped in jeweled bearings, *p*, having its axis coincident with that of the magnets *n*, *n*, and secured to the internal frame *i* on the insulating plates, *h*. Said internal frame, *i*, is made of brass, or other suitable material, and is held in a large brass frame *v* secured to the lower magnet, *n*, by screws, *t*, *t*. The base of said frame, *i*, has a short stout shaft, *i'*, which turns in a close fitting hole in the outer frame, *v*, and thereby permits axial adjustment so as to bring the index, *m*, to zero, also, vertical adjustment to bring the coils, *a*, *a*, into the centers of the spaces in which they move. Said frame, *v*, consists of a bottom-piece, *v'*, having two annular segments rising within and fitting against the magnets *n*, *n*, to near the top of the upper one which is fastened thereto by means of screws at, *r*, or in any other suitable manner. There are lugs, v^2, on the outer surface of the segments which hold said ring *g*. To one of said coils or loops, is attached a long and slender index, *m*, pointing in the same direction of the axes of the arms, *b*. Said index is, here, shown bent upward from its horizontal direction. Then it is again parallel to its first direction over a horizontal scale, *k*, and reflecting surface, k^2, beyond which it points downward in front of and parallel to a vertical scale, *k'*, and reflecting surface, k^3. The length of said scale is as great as the travel of said index, and the casing, *u*, which holds the magnets, is extended on one side to hold said scales and index. Said mirrors, k^2, k^3, serve to avoid parallax errors in reading the instrument. The coils, *a*, *a*, are wound with a single piece of fine insulated copper or other suitable wire, its middle por-

tion passing through the tubular arms, *b*, and one of its ends passing from one of said coils through one of said tubular arms to the insulated hub on the spindle, *e*, of one of the helical springs, *c*, and the other end of said wire from the other coil, *a*, through the opposite tubular arm, *b*, to the insulated hub of the other helical spring, *c*. The insulation of said hubs is a rubber, or equivalent material, tube on the shaft, *e*. The outer ends of said springs, *c*, are held by arms, *q*, which form a part of the rings, *d*, which are also insulated on said rubber pieces, *h*. Said arms, *q*, are connected by wires f', f^6 with the binding-posts, f^3, f^4, also with binding-posts f^5.

A resistance coil, in some convenient place, as under the scale, may be placed in circuit with the instrument whereby it may be made to answer as a voltmeter.

The manner in which the resistance-coil is connected is shown in the diagrammatic construction of the instrument shown in Fig. 6. When the current enters through the posts f^3 f^4 the instrument acts as an ammeter; when it passes through the posts f^3, f^5, (V A, and V) then as a voltmeter.

Only small fragments of the rings, *d*, are shown, in Fig. 6, with their arms, *q*.

There is a fuse f^2, in the circuit to prevent injury from excess of current.

Four blocks of fiber, *o*, or like suitable substance, keep the magnets and armature at proper distance from each other and at the same time act as stops to the motion of the coils *a*, and a wooden, or other suitable case, *u*, incloses the lower part of the instrument which also forms a base upon which the sheet-metal case *w*, is supported to inclose the scales and index and the moving coils and upper part of the instrument, generally, as shown. The joints formed by said metal casing are closed by strips of felt *w'* or other suitable material. The motion of the coils, *a*, is derived from the properly directed current in the looped conductors, said conductors moving in a field of uniform strength with lines of force in the proper direction as indicated.

It is evident that the top magnet may be omitted and that such an instrument would still be serviceable.

The radial extent of the magnetic field and armature are substantially alike—a general feature of my invention whereby the magnetic flux enters the sides instead of the edges of the armature which thus permits a construction through which may be attained the highest efficiency of a magnetic coil, or coils surrounding and deflected on said armature.

What I claim is—

1. The combination with bell-shaped magnets and annular armature between their poles, of a counteracted conductor surrounding said armature, an index and scale, substantially as specified.

2. The combination with permanent and similarly magnetic fields with a fixed armature and a scale, of an index and a looped conductor surrounding said armature, and mechanism to counteract said conductor, substantially as specified.

3. The combination with permanent magnetic fields with armature of substantially like radial area, of a pivoted conductor surrounding said armature, impelled in said field, and mechanism to return it to its starting point, substantially as specified.

4. The combination with permanent and similarly magnetic fields with armature and a scale, of an index and a looped conductor surrounding said armature and means to counteract said conductor, substantially as specified.

5. The combination with a permanent positive and negative pole with armature of substantially like radial area as said field, of a resisting couple and deflecting conductor on coincident centers, substantially as specified.

6. The combination with a magnetic field and armature, scale and mirror, of a deflecting coil surrounding said armature, with index to said scale on said coil, substantially as specified.

7. The combination with a magnetic field having an armature, scales at or near a right-angle to each other, of a deflecting coil surrounding said armature, with index for both of said scales, substantially as specified.

8. The combination with circular permanent and similar magnetic fields and armature therefor and a scale, of a movable looped conductor surrounding said armature centered in said field, an index to said scale and means to counteract said conductors, substantially as specified.

9. The combination with a scale, circular, permanent, and similarly magnetic fields and armature therefor with same axial centers, of movable diametrically opposed looped conductors surrounding said armature, on said center, an index to said scale on said conductor and means to counteract said conductors, substantially as specified.

10. The combination with a series of scales placed at different angles to each other, circular, permanent, and similarly magnetic fields facing each other, and armature therefor with same axial centers, of movable, looped, diametrically opposed conductors surrounding said armature on said center, an index to said scales on said conductor and means to counteract said conductor, substantially as specified.

11. The combination with one or more scales and mirror acting therewith, circular, permanent and similarly magnetic fields and armature therefor with same axial centers, of movable diametrically opposed, looped, conductors surrounding said armature, on the same center, an index to said scales, on said conductor, and means to counteract said conductors, substantially as specified.

12. The combination with permanent magnetic fields with a fixed armature and movable looped and counteracted conductors sur-

rounding said armature with index thereon, and scale, of a resistance coil in circuit with said parts, substantially as specified.

13. The combination with permanent similarly magnetic and opposite fields with a fixed armature surrounded by a moving looped counteracted conductor, an index on said conductor, of a resistance coil and scale, substantially as specified.

14. The combination with an armature and a pivoted deflecting coil thereon, of a concentrically pivoted index-adjusting support substantially as specified.

15. The combination with magnetic field and superimposed armature, of substantially like radial area, whereby said armature receives its magnetic flux from its sides instead of its edges, of a pivoted and looped conductor moving on said armature and mechanism to return it to its starting point, substantially as specified.

EDWARD W. JEWELL.

Witnesses:
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ISAAC BASSFORD.