No. 847,624. PATENTED MAR. 19, 1907.

T. W. VARLEY.

ELECTRICAL MEASURING INSTRUMENT.

APPLICATION FILED SEPT. 8, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

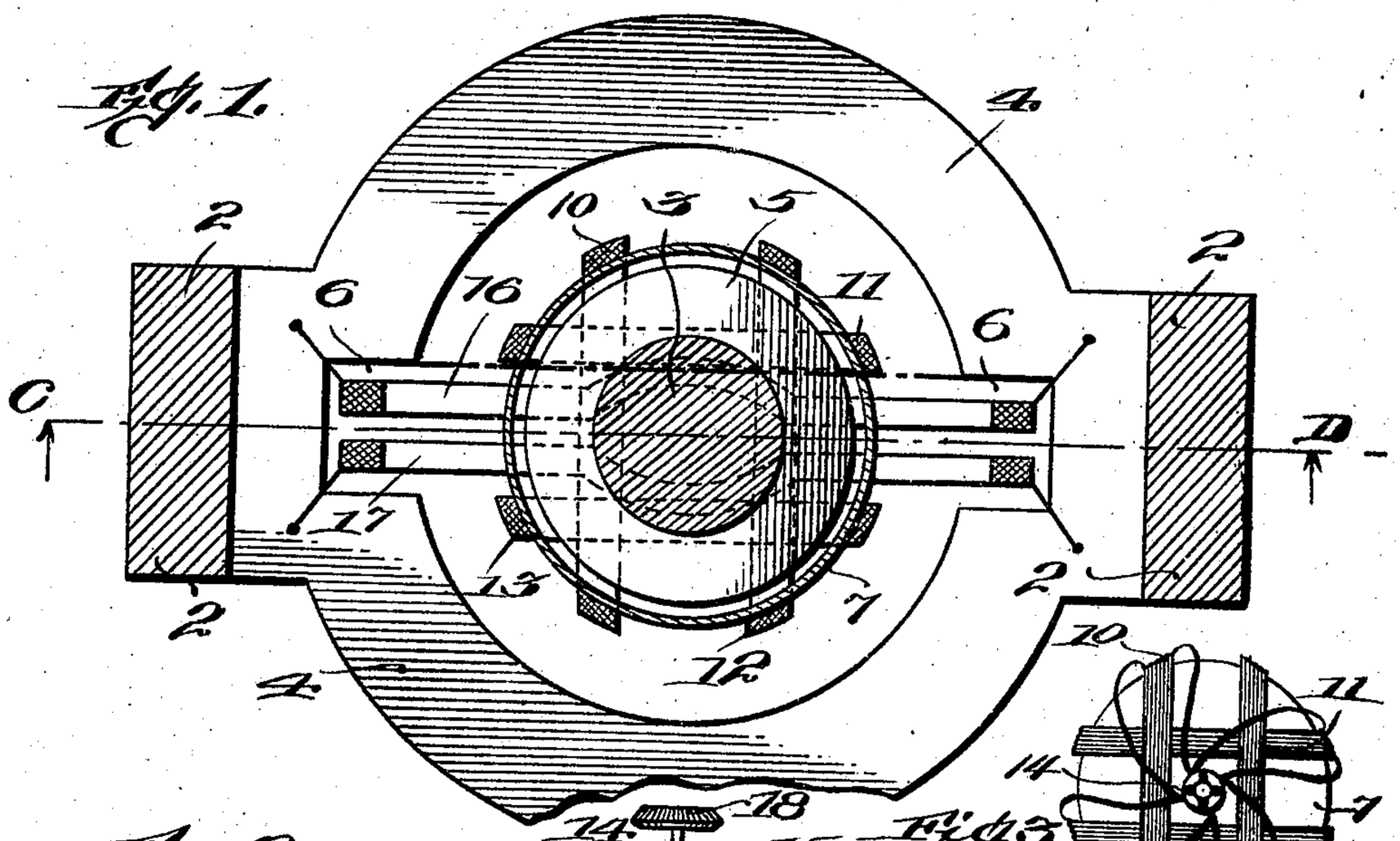
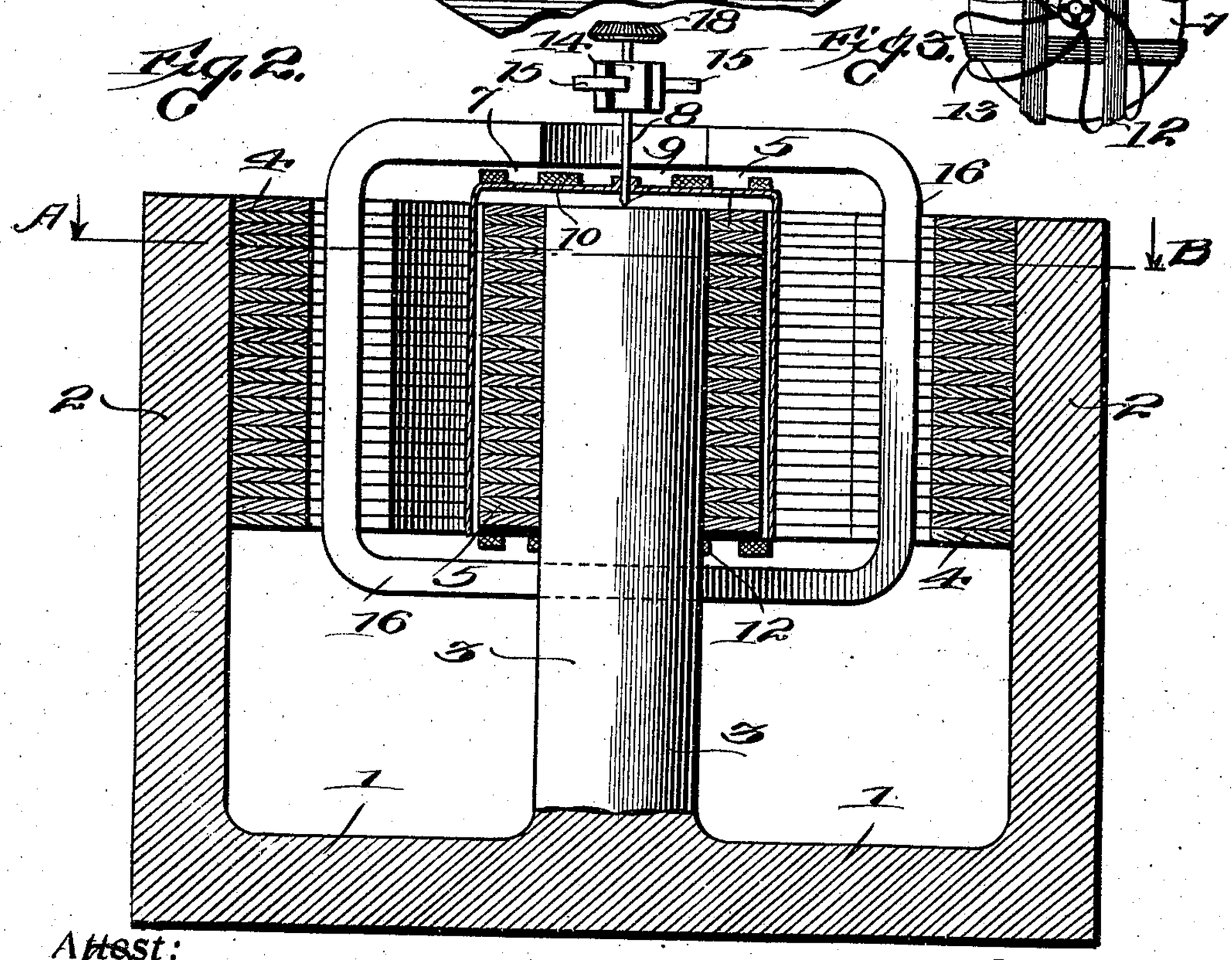


Fig. 3.

Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 4.

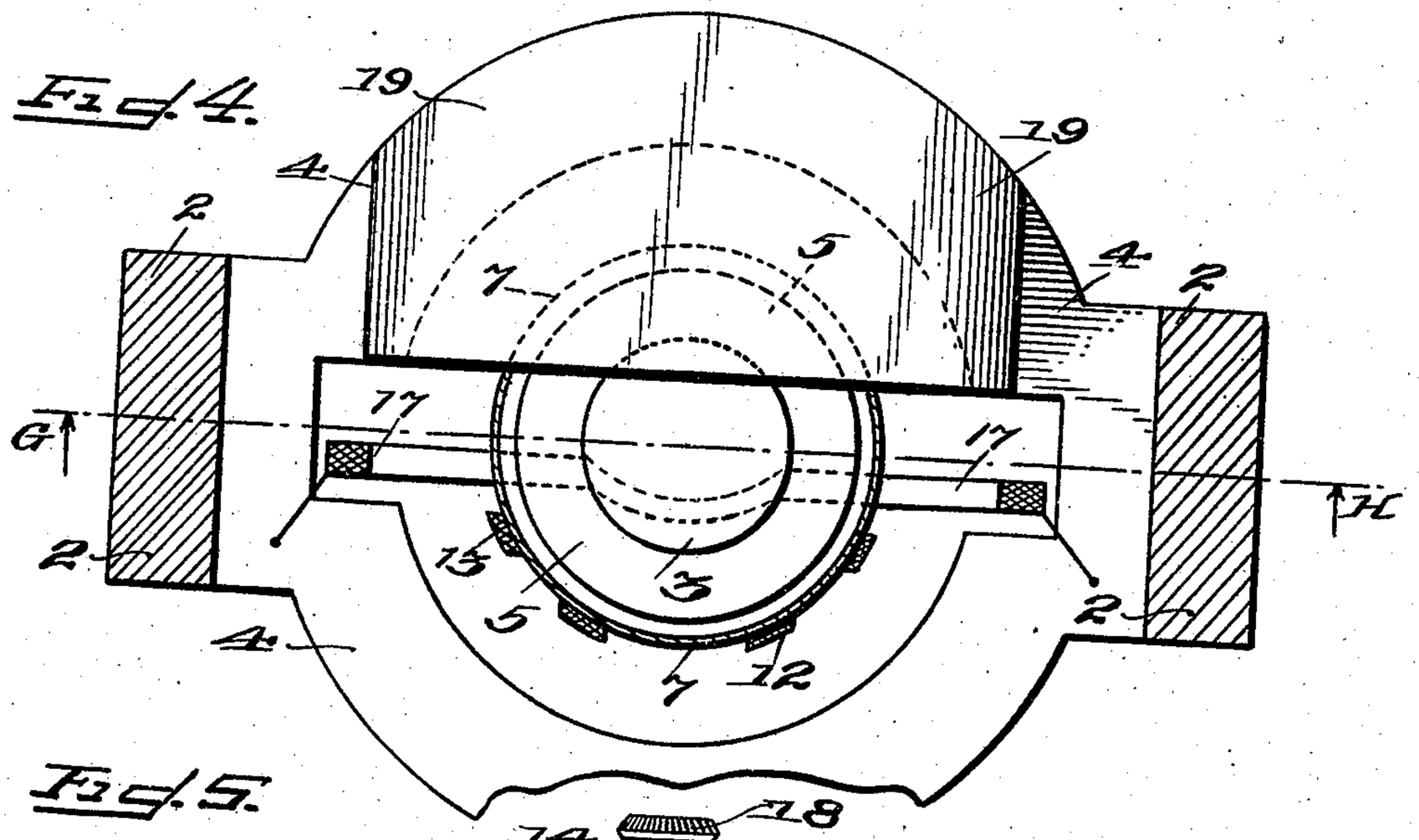

Fig. 5.

Witnesses

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UNITED STATES PATENT OFFICE.

THOMAS W. VARLEY, OF NEW YORK, N. Y.

ELECTRICAL MEASURING INSTRUMENT.

No. 847,624. Specification of Letters Patent. Patented March 19, 1907.

Application filed September 8, 1905. Serial No. 277,488.

To all whom it may concern:

Be it known that I, THOMAS W. VARLEY, a citizen of the United States, residing in the borough of Manhattan, city of New York, State of New York, have invented a new and useful Improvement in Electrical Measuring Instruments, of which the following is a specification.

My invention relates to electrical measuring instruments wherein advantage is taken of a substantially constant magnetic field, in combination with stationary and movable coils so disposed that a current passing through the stationary coil will shift or distort the lines of force of the constant magnet, but preferably without altering the total of such lines, in such manner that they will cause a torque on the movable coil, the function of the stationary coil being simply to so shift the lines of force in the constant magnetic field and not necessarily to create the magnetic field itself, as in the ordinary electric dynamometer.

In the following I have described, with reference to the accompanying drawings, a structure illustrating one embodiment of my invention, the features thereof being more particularly pointed out hereinafter in the claims.

In the drawings, Figure 1 is a cross-sectional view along the line A B of Fig. 2, illustrating a structure designed to be used as an integrating wattmeter. Fig. 2 is a longitudinal sectional view along the line C D of the structure shown in Fig. 1. Fig. 3 is a detail view to more clearly illustrate the windings of the movable coil. Fig. 4 is a plan view, partly in section, along the line E F of Fig. 5, illustrating a modification; and Fig. 5 is a longitudinal sectional view along the line G H of Fig. 4.

Similar numerals of reference indicate similar parts throughout the several views.

1 represents a substantially constant magnet, here shown in the form of a permanent magnet, having poles 2 2 of the same polarity and a central core 3 of opposite polarity to the poles 2 2. The constant magnet is provided with a soft-iron pole-piece 4, preferably of laminated plates and concentric with the core 3, as shown. Supported on the core 3 and also concentric therewith is a soft-iron pole-piece 5, preferably of laminated plates. The pole-piece 4 is provided with slots 6 6, preferably oppositely-disposed and causing gaps in the magnetic field, for the purpose hereinafter stated. A cup 7, preferably of aluminium, is disposed in the air-gap between the pole-pieces 4 and 5, surrounding the latter. The cup 7 is supported on shaft 8, which latter has a bearing 9 on the top of core 3, the other end of shaft 8 being supported in any suitable manner. (Not shown.) Windings 10, 11, 12, and 13 are mounted on cup 7 in series with each other and connected to the commutator 14 on shaft 8, as shown in Fig. 3, the windings forming a closed-circuit armature. Brushes 15 15 introduce current to the commutator. Fixed coils 16 and 17 are supported in any suitable manner around the cup 7, as shown.

In Fig. 2 the fixed coils are shown as supported in the slots 6 6, being separated in the center to avoid the shaft 8 and the core 3, one of said fixed coils, as 16, being in the same circuit as the windings 10, 11, 12, and 13 of the armature and the other, as 17, independent of said circuit. At the upper end of the shaft 8 is a gear-wheel 18, adapted to actuate any suitable indicating mechanism. (Not shown.)

The current from the mains (not shown) or the pressure controlled by a suitable resistance (not shown) flows through the windings 10, 11, 12, and 13 and one of the fixed coils, as 16, so that the current in this circuit will vary as the pressure of the mains. The other fixed coil, as 17, is in series or shunt to the main circuit, so that its current varies proportionately to the main-circuit current. With no current flowing in coil 17 the armature is in a balanced condition with reference to the constant magnetic field and has no tendency to rotate, because the torques exerted on opposite sides of the armature are equal and opposite. The function of fixed coil 16 is to produce a slight distortion of the field in order to overcome the initial rotative friction of the armature, or coil 16 may be used to aid in balancing the two sides of the concentric field. This can also be done by a magnetic shunt or piece of soft iron 19 partially bridging one side of the concentric field, as shown in Figs. 4 and 5, the coil 16 being omitted, the effect being similar to the function of fixed coil 16 in this respect, as described. The function of fixed coil 17 is to cause the magnetic field to become unbal-

anced, one face of the fixed coil becoming weaker relatively to the opposite face, and consequently the torque exerted on the opposite sides of the armature become unbalanced also and the armature rotates as the difference of strength of the two magnetic fields.

The instrument becomes a wattmeter because the torque exerted on the armature to cause its rotation is the product of the currents in the windings of the armature and the magnetic field—that is, the unbalanced portion thereof. As one effect is caused by the voltage applied to the load and the other by the current to the load, the product of these two is watts.

As the armature-windings are mounted on the cup and cause it to rotate with them, the cup exerts a drag tending to stop rotation, this drag being proportional to the speed of rotation of the armature, so that the instrument becomes a watt-hour meter. The function of slots 6 6 is to cause the cup 7 to rotate in changing magnetic fields, causing currents to be set up in the cup tending to stop its rotation. The drag upon the cup is constant in amount for any particular speed and independent of the current flowing in fixed coils 16 and 17, because as one face increases the other decreases, the sum being a constant quantity, the drag being caused by the difference in magnetic lines between the sum of the faces and the slots.

The principle of the invention as shown and described is applicable to either alternating or direct currents and may be utilized in the construction of voltmeters and ammeters as well as in either integrating or indicating wattmeters, as is clear to any one skilled in the art.

It is obvious that the details illustrated may be considerably varied, that the constancy of the magnet may vary within limits and parts and functions transposed without departing from the spirit of my invention, and I do not restrict myself to any of the details as shown and described.

What I claim, and desire to secure by Letters Patent, is—

1. In an apparatus of the character described, a substantially constant magnet for creating a field of force comprising an outer pole of one polarity and an inner pole of the opposite polarity, a stationary coil adapted to shift the lines of force of the constant magnetic field and a movable coil in the magnetic field normally in a balanced condition relative thereto but becoming unbalanced when the magnetic field is shifted.

2. In an apparatus of the character described, a substantially constant magnet for creating a field of force comprising opposite poles of the same polarity and a pole substantially concentric with the opposite poles and of the opposite polarity, a stationary coil adapted to shift the lines of force of the constant magnetic field and a movable coil in the magnetic field normally in a balanced condition relative thereto but becoming unbalanced when the magnetic field is shifted.

3. In an apparatus of the character described, a substantially constant magnet for creating a field of force comprising an outer pole of one polarity, a pole-piece within said pole, an inner pole of opposite polarity substantially concentric with said outer pole and pole-piece, a stationary coil adapted to shift the lines of force of the constant magnetic field and a movable coil in the magnetic field normally in a balanced condition relative thereto but becoming unbalanced when the magnetic field is shifted.

4. In an apparatus of the character described, a substantially constant magnet for creating a field of force comprising opposite poles of the same polarity, a pole-piece connecting said poles and a pole substantially concentric with said opposite poles and of the opposite polarity, a stationary coil adapted to shift the lines of force of the constant magnetic field and a movable coil in the magnetic field normally in a balanced condition relative thereto but becoming unbalanced when the magnetic field is shifted.

5. In an apparatus of the character described, a substantially constant magnet for creating a field of force, a stationary coil adapted to shift the lines of force of the constant magnetic field, a movable coil in the magnetic field normally in a balanced condition relative thereto but becoming unbalanced when the magnetic field is shifted and an adjusting-coil adapted to cause an initial unbalance of the movable coil.

6. In an apparatus of the character described, a substantially constant magnet for creating a field of force, a stationary coil adapted to shift the lines of force of the constant magnetic field, a movable coil in the magnetic field normally in a balanced condition relative thereto but becoming unbalanced when the magnetic field is shifted and means adapted to cause an initial unbalance of the movable coil.

7. In an apparatus of the character described, a substantially constant magnet for creating a substantially uniform field of force in a radial direction, a stationary coil adapted to shift the lines of force of the constant magnetic field and a movable coil in the magnetic field normally in a balanced condition relative thereto but becoming unbalanced when the magnetic field is shifted.

8. In an apparatus of the character described, a substantially constant magnet for creating a substantially uniform field of force in a radial direction, a stationary coil adapted to shift the lines of force of the con-

stant magnetic field and a movable member in the magnetic field so wound as to produce a two-pole armature and normally in a balanced condition relative thereto but becoming unbalanced when the magnetic field is shifted.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

THOMAS W. VARLEY.

Witnesses:
SEABURY C. MASTICK,
T. FRANK WOODSIDE.