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ELECTRICAL REMOTE-READING POSITION-INDICATING APPARATUS

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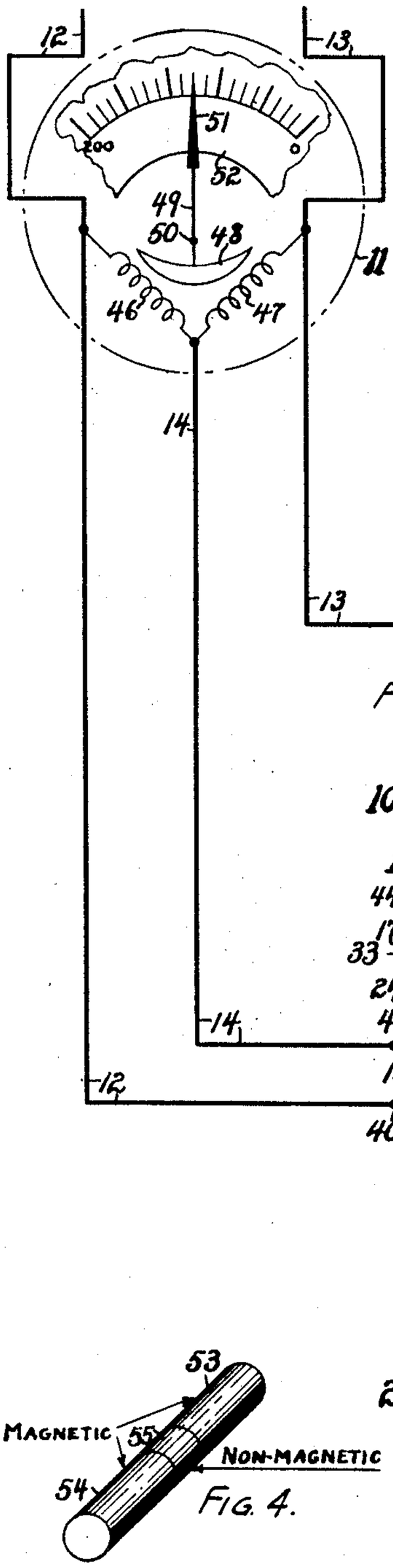

FIG. 1.

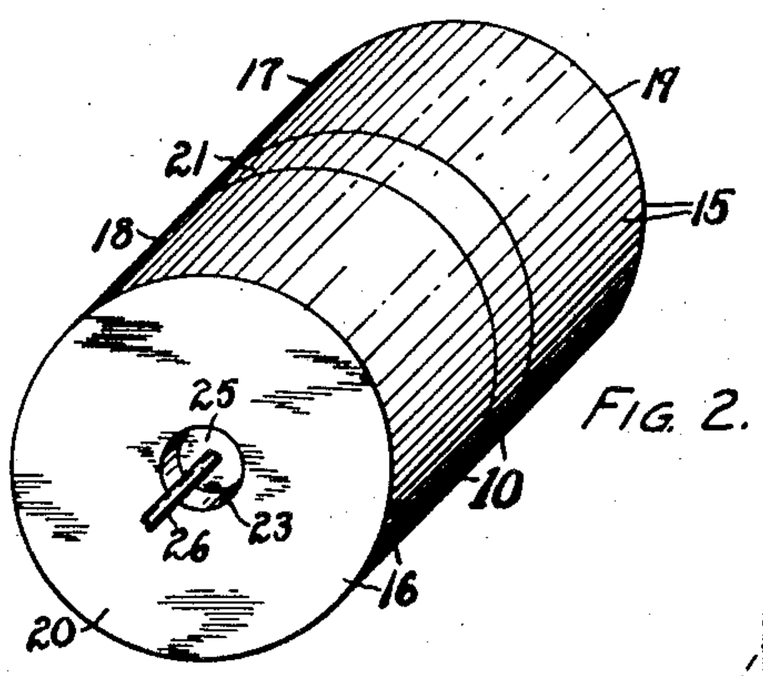

FIG. 2.

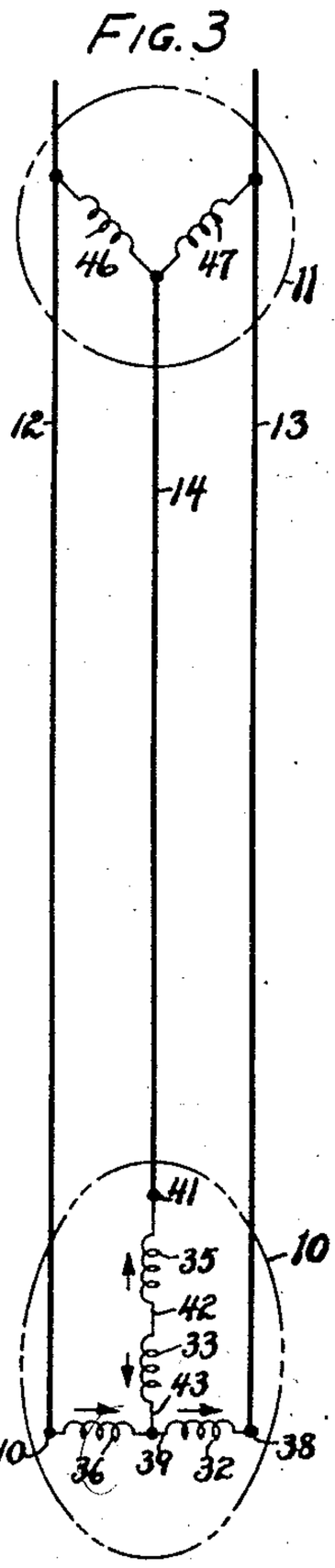

FIG. 3.

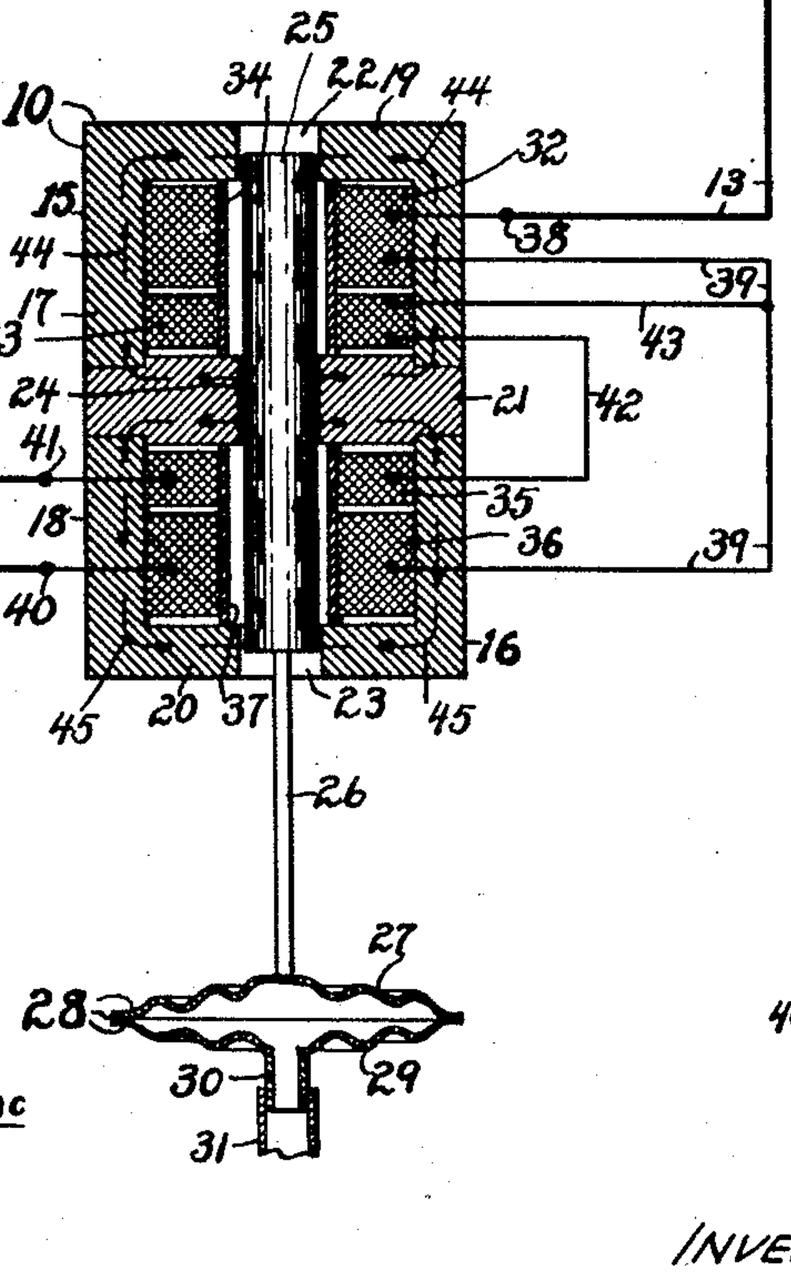

FIG. 4.

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ELECTRICAL REMOTE-READING POSITION-INDICATING APPARATUS

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4 Claims. (Cl. 177—351)

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The present invention relates to improvements in position-indicating apparatus and relates more particularly to improvements in electrical remote-reading position-indicating apparatus, i. e., position-indicating apparatus of the type wherein a transmitting- or detecting-portion of the apparatus may be situated at one station or location and electrically connected to a receiving- or indicating-portion of the apparatus which may be situated at a different station or location.

One of the objects of the present invention is to provide a superior electrical remote-reading position-indicating apparatus or system which will accurately and reliably measure variable conditions existing at one station and indicate such measurements at a relatively-remote point.

Another object of the present invention is to provide a superior position-indicating apparatus of the character referred to which will be substantially unaffected by wide ranges of temperature-changes to which the apparatus may be subjected.

A further object of the present invention is to provide a superior apparatus of the character referred to having a high degree of compactness and freedom from troublesome sliding contact, etc.

Still another object is to provide a simple, reliable and compact detecting-transmitter unit capable of use in conjunction with an indicating-unit and characterized by a superior degree of sensitiveness.

With the above and other objects in view, as will appear to those skilled in the art from the present disclosure, this invention includes all features in the said disclosure which are novel over the prior art and which are not claimed in any separate application.

In the accompanying drawings, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a schematic view of one form of remote-reading position-indicating apparatus embodying the present invention and showing the armature or core of the detecting-transmitter device in its neutral or intermediate positions;

Fig. 2 is a perspective view of the detecting-transmitter unit;

Fig. 3 is a diagrammatic showing of the circuit indicated in Fig. 1; and

Fig. 4 is a perspective view of a substitute form of armature or core.

The structure of Figs. 1, 2 and 3

The particular position-indicating apparatus

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illustrated in Figs. 1, 2 and 3 comprises two main units or devices which may be respectively aptly termed a detecting-transmitter unit generally designated by the reference character 10, and an indicating-receiver unit generally designated by the reference character 11.

The two devices 10 and 11 above referred to are electrically interconnected by complemental line-wires 12 and 13 and by an interconnecting-wire 14. The complemental line-wires 12 and 13 may be connected to any suitable source of alternating or pulsating current such, for instance, as 400-cycle, 10-volt alternating current.

The detecting-transmitter device 10 includes two opposed cup-shaped body-members respectively designated by the reference characters 15 and 16 respectively having flange-portions 17 and 18 and respectively having end-walls 19 and 20, which latter are located at the respective opposite ends of the assembly.

The opposed inner ends of the flange-portions 17 and 18 are respectively seated against shouldered opposite faces of a disk-like intermediate wall-member 21, which latter in a manner as will hereinafter appear, serves to provide two magnetic paths. The end-wall 19 of the body-member 15 is formed with an axial passage 22 corresponding in size to and located in axial alignment with a similar passage 23 formed in the end-wall 20 of the body-member 16. The intermediate wall-member 21 is also formed with an axial passage 24 which corresponds in size to and is located in axial alignment with the passages 22 and 23 just referred to.

Mounted for axial reciprocation in the interior of the assembly and in the respective axial passages 22, 23 and 24 of the elements 15, 16 and 21, is a core-like armature 25. The said armature 25 freely fits the passages 22, 23 and 24 so as to readily reciprocate therein and is provided with a rigid operating-rod 26 by means of which the said armature may be moved axially with respect to the remainder of the detecting-transmitter device 10. The operating-rod 26 may be connected to any device or apparatus, the position or movement of which it is desired to indicate by means of the indicating-receiver device 11 or its equivalent.

The elements 15, 16, 21 and 25, before referred to, are preferably formed of powdered iron in order to minimize the effects of eddy currents, though the said parts may be formed from laminated steel or iron, if desired.

In the instance shown, the outer end of the operating-rod 26 is connected to one flexible

diaphragm-like wall 27 of an expansible pressure-chamber 28, which latter also includes a complemental flexible diaphragm-like wall 29. The two walls or diaphragms 27 and 29 are secured together adjacent their outer edges and the said wall 29 is centrally apertured and has an axially-extending tubular sleeve 30 rigidly projecting therefrom. The said sleeve 30 may be connected to a tube or pipe 31 leading from any suitable source of fluid, the pressure of which it is desired to measure or indicate.

Mounted within the flange-portion 17 of the body-member 15 intermediate the end-wall 19 and the intermediate wall-member 21, is a primary-coil 32 and a complemental secondary-coil 33, both of ring-like form and mounted upon a common tubular sleeve or bushing 34. The bushing 34 has an internal diameter sufficient to freely clear the armature 25.

Mounted within the flange-portion 18 of the body-member 16 in a position intermediate the end-wall 20 and the intermediate wall-member 21, is a secondary-coil 35 and a complemental primary-coil 36 jointly mounted upon a sleeve or bushing 37. The said sleeve or bushing, like the sleeve or bushing 34, has an internal diameter sufficient to permit the free axial movement of the armature 25.

Both of the primary-coils 32 and 36 and both of the secondary-coils 33 and 35 are arranged coaxially so that the core-like armature 25 may be moved axially through all thereof.

One end of the primary-coil 32 is provided with a terminal 38 to which is connected the adjacent end of the line-wire 13. The opposite end of the primary-coil 32 is connected by a wire 39 to one end of the primary-coil 36. The remaining end of the primary-coil 36 extends to a terminal 40 to which is connected the adjacent end of the line-wire 12.

The secondary-coil 35 has one end provided with a terminal 41 to which is connected the adjacent end of the interconnecting-wire 14 before referred to. The opposite end of the secondary-coil 35 is connected to one end of the other secondary-coil 33 by means of a wire 42. The remaining end of the secondary-coil 33 is connected by means of a wire 43 to the wire 39 which serves to interconnect the primary-coils 32 and 36.

From the foregoing it will be seen that the primary-coils 32 and 36 are connected in series with each other and with the line-wires 12 and 13. It will also be seen that the two secondary-coils 33 and 35 are connected in series with each other between the interconnecting-wire 14 and a point in the circuit intermediate the two primary-coils 32 and 36 (the wire 39). The two secondary-coils 33 and 35 are so connected that their respective voltages are opposing, while the respective voltages of the primary-coils 32 and 36 are in the same direction. The voltage relationships just referred to are indicated by the arrows in Fig. 3.

As thus constructed and arranged, the body-member 15 in conjunction with the intermediate wall-member 21, provides a magnetic path for the flux developed by the primary-coil 32 and the secondary-coil 33, as indicated by the arrows 44 which indicate the flux-direction for a given half-cycle of alternating current. Similarly, the body-member in conjunction with the intermediate wall-member 21, provides a path for the magnetic flux developed by the primary-coil 36 and its complemental secondary-coil 35, as indicated by the arrows 45 for a given half-cycle of alternating current occurring at the same instant as previously described in connection with the primary-coil 32 and secondary-coil 33.

The indicating-receiver or motion-indicating device 11 may be in the form of any suitable ratiometer and in the instance shown includes two complemental coils 46 and 47. The respective inner terminals of the coils 46 and 47 are connected to the interconnecting-wire 14, while the respective outer ends of the coils 46 are respectively connected to the line-wires 12 and 13.

The indicating-receiver device or motion-indicating device 11 also includes an armature 48 carried at the inner end of a lever 49. The said lever is pivoted intermediate its respective opposite ends as at 50 and is provided at its outer end with a pointer 51 adapted to sweep over suitable indicia, printed or otherwise applied to the surface of a dial-plate 52.

The construction and arrangement of the parts of the unit 11 are such that the armature 48 assumes a position such that the forces exerted on it by the coils 46 and 47 are equal and opposite. Hence a change in the ratio between the respective currents flowing through the respective coils 46 and 47 will cause corresponding changes in the opposing forces acting on the armature 48 and thus cause a change in the position of both the said armature and the pointer 51.

Operation

When the armature 25 is in the intermediate position in which it is shown in Fig. 1 of the drawings, the respective reluctances of the flux-paths represented by the arrows 44 and 45 are equal and hence the voltages across the respective coils 46 and 47 of the indicating-receiver unit 11 will be equal. Under these circumstances, the pointer 51 will assume substantially the position in which it is shown in Fig. 1.

For purposes of description, let it now be assumed that the core-like armature 25 is moved downwardly from the position in which it is shown in Fig. 1 of the drawings. Under these conditions, the reluctance of the flux-path represented by the arrows 44 will increase, whereas the reluctance of the flux-path represented by the arrows 45 will correspondingly decrease.

With the cores shifted downwardly as above referred to, there will be an increase in the voltage applied across the primary-coil 36 and an increase in the voltage induced in the complemental secondary-coil 35. Coincidentally, there will be a reduction in the voltage applied across the primary-coil 32 and a decrease in the voltage induced in its complemental secondary-coil 33. These respective increases and decreases as just above described, will be a function of the position attained by the said armature 25.

The voltage increases above referred to in connection with the coils 36 and 35 will cause an increase in the voltage applied across the coil 46 of the indicating-receiver unit 11, while the coincidental decrease in the voltages appearing across the coils 32 and 33 will cause a corresponding reduction in the voltage applied across the coil 47 of the unit 11.

The above-described changes in voltages applied across the respective coils 46 and 47 will cause the pointer 51 to be deflected in a clockwise direction as viewed in the drawings. The degree of movement of the pointer 51, will, of course, be a function of the degree of movement imparted to the armature 25.

Should the armature 25 be moved upwardly to

a position above the position in which it is shown in Fig. 1, the reluctance of the flux-path represented by the arrows **44** will be decreased, while the reluctance of the flux-path represented by the arrows **45** will be correspondingly increased. In this manner, the voltage applied across the primary-coil **32** will be increased, as will also the voltage induced in the secondary-coil **33**. Coincidentally, the voltage applied across the primary-coil **36** will be decreased and the induced voltage in the secondary-coil **35** will be decreased. Under these circumstances, the voltage applied across the coil **47** of the unit **11** will be increased, while the voltage applied across the opposite coil **46** of the said unit will be decreased. Under these latter conditions, the pointer **51** will be deflected in a counterclockwise direction to a degree which will be a function of the degree to which the armature **25** has been shifted upwardly beyond its intermediate position.

From the foregoing it will be seen that the position of the pointer **51** at any given time depends upon the position of the armature **25** at such time. Any shift in the position of the said armature **25** will cause a proportionate shift in the position of the pointer **51** or its equivalent.

From the foregoing it will also be seen that any change in the position of the core-like armature **25** will occasion a voltage-change across each of the coils **32**, **33**, **35** and **36**. The integrated effect of the four voltage-changes just referred to will be evidenced by the change in the position of the pointer **51**.

Attention is further called to the fact that in the embodiment of the invention herein shown, each primary-coil and its complemental secondary-coil are provided with independent flux-paths. Thus, the primary-coil **32** and its complemental secondary-coil **33** may have the flux path **4**, while the primary-coil **36** and its complemental secondary-coil **35** are provided with the flux-path **45**. It is preferred and as shown in Fig. 1, that the coils be so arranged that the flow of flux through the intermediate wall-member **21** is in the same direction at any given instant to thus avoid having the flux in one flux-path buck the flux in the other flux-path.

The armature of Fig. 4

Instead of employing an armature such as **25** formed throughout its length of magnetic material, an armature such as is shown in Fig. 4 may be employed.

The armature referred to consists of two opposite end-portions **53** and **54** formed of sintered iron or other suitable magnetic material, and rigidly connected together by a non-magnetic spacer **55** formed of any suitable non-magnetic material. The respective lengths of the end-portions **53** and **54** are such as to enable them to respectively discharge the function of forming parts of the flux-paths **44** and **45** indicated in Fig. 1.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

We claim:

1. A detecting-transmitter unit for remote-reading position-indicating apparatus, including

in combination: a pair of primary-coils connected in series with each other and each having a terminal constructed and arranged for connection to an electrical indicating-device; a pair of secondary-coils respectively located adjacent to and in the field of one of the two said primary-coils and electrically connected together so that the voltage induced in one thereof is in opposition to that induced in the other, each of the said secondary-coils having a terminal opposite its point of connection to the other secondary-coil, the terminal of one of the said secondary-coils being connected to the junction between the two said primary-coils, and the terminal of the other secondary-coil being constructed and arranged for connection to an electrical indicating-device; an armature-member having a portion movable in the field of one of the said primary-coils and its complemental secondary-coil, the said armature-member also having a portion movable in the field of the other of said primary-coils and its complemental secondary-coil; and flux-conducting means formed of magnetic material and constructed and arranged in conjunction with the respective portions of the said armature-member to provide two distinct flux-paths respectively extending around one of the said primary-coils and its adjacent complemental secondary-coil.

2. A detecting-transmitter unit for remote-reading position-indicating apparatus, including in combination: a pair of substantially concentrically-arranged ring-like primary-coils connected in series with each other and each having a terminal constructed and arranged for connection to an electrical indicating-device; a pair of ring-like secondary-coils substantially concentric with the said pair of primary-coils and respectively located adjacent to and in the field of one of the two said primary-coils, the said pair of secondary-coils being electrically connected together so that the voltage induced in one thereof is in opposition to that induced in the other, each of said secondary-coils having a terminal opposite its point of connection to the other secondary-coil, the terminal of one of the said secondary-coils being connected to the junction between the two said primary-coils, and the terminal of the other secondary-coil being constructed and arranged for connection to an electrical indicating-device; a bar-like armature-member having a portion movable longitudinally in the field of one of the said primary-coils and its complemental secondary-coil, the said armature-member also having a portion movable longitudinally in the field of the other of said primary-coils and its complemental secondary-coil; and flux-conducting means formed of magnetic material and constructed and arranged in conjunction with the respective portions of the said armature-member to provide two distinct flux-paths respectively extending around one of the said primary-coils and its adjacent complemental secondary-coil.

3. A detecting-transmitter unit for remote-reading position-indicating apparatus, including in combination: a pair of substantially concentrically-arranged ring-like primary-coils connected in series with each other and each having a terminal constructed and arranged for connection to an electrical indicating-device; a pair of ring-like secondary-coils substantially concentric with the said pair of primary-coils and respectively located adjacent to and in the field of one of the two said primary-coils, the said

pair of secondary-coils being electrically connected together so that the voltage induced in one thereof is in opposition to that induced in the other, each of the said secondary-coils having a terminal opposite its point of connection to the other secondary-coil, the terminal of one of the said secondary-coils being connected to the junction between the two said primary-coils, and the terminal of the other secondary-coil being constructed and arranged for connection to an electrical indicating device; a bar-like armature-member having a portion movable longitudinally in the field of one of the said primary-coils and its complemental secondary-coil, the said armature-member also having a portion movable longitudinally in the field of the other of said primary-coils and its complemental secondary-coil; and a casing formed of magnetic material and constructed and arranged in conjunction with the respective portions of the said armature-member to provide two distinct flux-paths respectively extending around one of the said primary-coils and its adjacent complemental secondary-coil.

4. A detecting-transmitter unit for remote reading position-indicating apparatus, including in combination: a pair of substantially concentrically-arranged ring-like primary-coils connected in series with each other and each having a terminal constructed and arranged for connection to an electrical indicating-device; a pair of ring-like secondary-coils substantially concentric with the said pair of primary-coils and respectively located adjacent to and in the field of one of the two said primary-coils, the said pair of secondary-coils being electrically connected together so that the voltage induced in one thereof is in opposition to that induced in the other, each of the said secondary-coils having a terminal opposite its point of connection to the other secondary-coil, the terminal of one of the said secondary-coils being connected to the junction between the two said primary-coils,

and the terminal of the other secondary-coil being constructed and arranged for connection to an electrical indicating-device; a bar-like armature-member having a portion movable longitudinally in the field of one of the said primary-coils and its complemental secondary-coil, the said armature-member also having a portion movable longitudinally in the field of the other of said primary-coils and its complemental secondary-coil; and a casing formed of magnetic material and enveloping the said primary-coils and the said secondary-coils, the said casing being formed with two end-walls extending radially inwardly into proximity to the said armature-member and also provided intermediate its respective opposite ends with an intermediate wall extending radially inwardly into proximity to the said armature-member and located between one of the said primary-coils and its complemental secondary-coil on the one hand and the other of the said primary-coils and its complemental secondary-coil on the other hand.

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