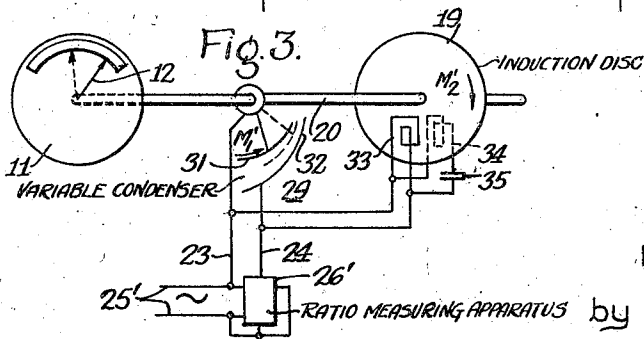
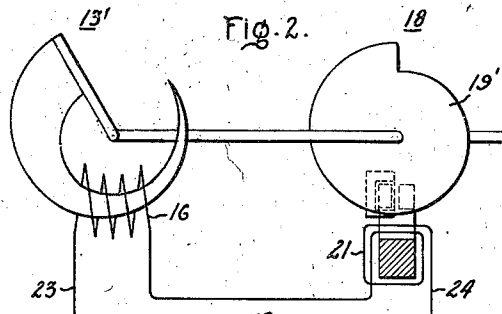
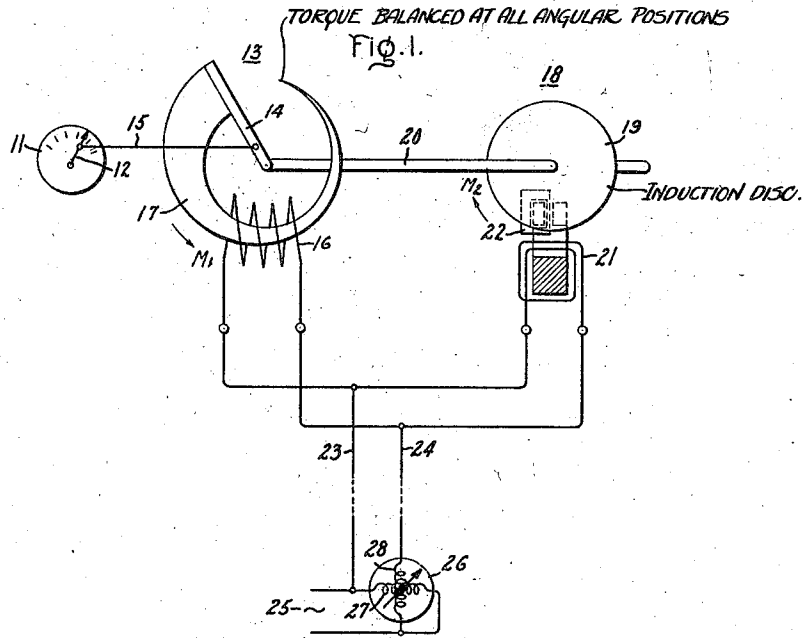


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TELEMETERING SYSTEM
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TELEMETERING SYSTEM

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6 Claims. (Cl. 177—351)

My invention relates to telemetering systems and concerns particularly systems in which a transmitted current is varied by means of a variable impedance in response to variations in a measurement or indication to be transmitted.

It is an object of my invention to provide a telemetering system in which only two conductors are required to connect transmitting and receiving stations and in which the accuracy is increased by eliminating movable contacts and the attendant variable contact resistance.

It is also an object of my invention to provide an arrangement which is independent of possible variations in voltage of the current-supply source.

Other and further objects and advantages will become apparent as the description proceeds.

Various forms of telemetric systems are known in which indications are transmitted by variations in strength of the transmitted current. The current variations may be produced by means of a variable resistor or a potentiometer having a movable contact mechanically connected to the indicating arm of an instrument, the indications of which are to be transmitted. In such systems, however, the accuracy is impaired by the presence of the contact resistance of the movable contact. In order to minimize the effect of the contact resistance, it becomes necessary to employ more than two conductors between the transmitting and receiving stations for the purpose of using some sort of ratio method.

The disadvantages of movable contacts may be overcome by utilizing a variable reactance or impedance instead of a rheostat or potentiometer since a reactor may be constructed to have its impedance varied by moving the relative positions of the exciting winding and an armature of the vane or coil type. In such reactors having relatively movable members, however, the reaction between the members produces forces which tend to interfere with the setting of the position of the movable member by the movable pointer of the sending instrument and prevent obtaining a proper indication.

In accordance with my invention in its preferred form, I utilize a variable reactor or impedance having a regulating arm mechanically connected to the indicating pointer of an instrument, the indications of which are to be transmitted, and I also utilize a force-producing element mechanically connected to the variable reactor to overcome the force produced by the reaction between the relatively movable members and having an exciting winding supplied by the same source of current as the exciting winding

of the variable reactor. The parts are so arranged that the force produced by the auxiliary force-producing element varies in the same manner as the reaction between the elements of the variable reactor so that the reaction is balanced at all points.

The features of my invention which I believe to be novel and patentable will be pointed out in the claims appended hereto. A better understanding of my invention, however, may be obtained by referring to the following description taken in connection with the accompanying drawing illustrating one embodiment of my invention in Fig. 1, by means of a schematic diagram showing the electrical circuits, illustrating another embodiment in Fig. 2 by a partial view and illustrating another embodiment of my invention in Fig. 3.

Referring more in detail to Fig. 1 of the drawing, a sender measuring or indicating instrument 20 of any desired type is represented at 11 having a movable pointer 12, the indication of which is to be transmitted to a receiving station remote from the transmitting station at which the instrument 11 is located. A variable impedance 25 13 is provided having a regulating arm 14 mechanically connected in any suitable manner as by means of a rod 15 to the movable pointer 12 of instrument 11. The instrument 11 is merely represented schematically and appears relatively small in comparison with the impedance 13. However, it will be understood that the indicating instrument employed ordinarily has a movement as great in size as the variable impedance 13 in order to insure ample torque for overcoming friction although, as explained hereinafter, I provide a balanced arrangement in which very little torque is required to be excited by the indicating instrument.

In the arrangement illustrated, the variable impedance 13 consists of a stationary exciting winding 16 and a movable armature 17 comprising a sickle-shaped vane of iron or other magnetic material but it will be understood that my invention is not limited to this exact arrangement but, obviously, includes variable impedances of any desired type having relatively movable elements reacting electromagnetically or electrostatically. The impedance of the winding 16 obviously varies in accordance with the angular position of the regulating arm 14 and the sickle-shaped vane 17 since the reluctance of the flux path through winding 16 varies in accordance with variations in the cross section of the portion of the vane 17 located within the wind- 55

ing 16. By virtue of the fact, however, that the reluctance varies with variations in angular position of the vane 17, there is a force produced between winding 16 and the vane 17 acting in a counterclockwise direction, as shown by the arrow M1, tending to draw the vane 17 into the position of minimum reluctance.

In order to overcome this torque, I provide a torque or force-producing unit 18 having a movable member 19 mechanically connected to the movable member of reactor 13 in any desired manner as by means of shaft 20. The torque-producing unit 18 may comprise any suitable device, preferably one having a torque or force which varies substantially in the same manner as the force produced by the reaction between winding 16 and vane 17 of variable reactor 13. For example, I may employ an induction disc motor having a rotor comprising a rotatable disc 19 cooperating with a stator comprising a stationary winding 21 on a shaded pole field structure carrying a shading coil 22 to produce a shifting magnetic field acting upon the disc 19 to produce a torque M2 acting in a clockwise direction to balance the torque M1 produced in the variable reactor 13. Windings 16 and 21 are connected in series or parallel to a pair of conductors 23 and 24 leading to a source of alternating current 25 at the receiving station.

In the arrangement shown, in Fig. 1, the windings are connected in parallel and the torque produced in units 13 and 18 tends to vary in accordance with the square of the voltage of the supply source 25. However, it will be understood that, if desired, I may substitute units producing torques varying in a different manner with variations in voltage (or current in case of series connection) but, preferably, the relationship between torque and voltage (or current) is similar in both units in order that the torques will be balanced irrespective of voltage variations.

In the arrangement of Fig. 1, the rate of change of cross-sectional area of the vane 17 with respect to the angle through which the vane rotates is assumed to be such that a constant rate of change of reluctance with respect to the angle of deflection is obtained with a result that the torque of the unit 13 is independent of the angular position of the movable member. Since the inductance disc motor unit 18 employs a uniform circular disc 19, its torque will also be independent of angular position. If desired, however, torque balance for different angular positions may also be obtained without maintaining a constant rate of change of reluctance with respect to angular deflection in the unit 13. The torque produced by unit 18 may then be appropriately varied for different angular positions in any desired manner as by changing the composition, thickness, or radius of the disc 19 in different portions of its periphery.

Fig. 2 illustrates such an arrangement in which the unit 13' does not have a constant rate of change of reluctance with respect to angular deflection and the induction disc 19' is made cam-shaped with a variable radius to compensate for variations in torque with respect to angular deflection of the unit 13.

Fig. 2 also illustrates an arrangement in which the windings 16 and 21 are connected in series so that the torques of the opposing units 13' and 18 vary substantially as the square of the current in the conductors 23 and 24.

At the receiving station, I provide a suitable

current-responsive receiver instrument 26, such as a crossed-coil ratio instrument or impedance meter, for example, having cooperating crossed coils 27 and 28. One of the coils 27, which may be referred to as the potential coil, is connected across the source of current 25 and the other coil 28, which may be referred to as the current coil is connected in series with one of the conductors 24 joining the transmitting and receiving stations so that the instrument 26 measures the ratio between the current and voltage supplied by the source 25 or the impedance of the load supplied by the source 25. The impedance obviously varies as the position of the regulating arm 14 of variable reactor 13' is varied in accordance with movements of the indicating arm 12 of instrument 11. Consequently, the reading of the instrument 26 at the receiving station provides an indication of the reading of the instrument 11 at the transmitting station.

In the arrangement of Fig. 3, the variable impedance controlled by the movable element of the instrument 11 takes the form of an electrostatic or capacitive impedance or variable condenser 29. The variable condenser 29 has a pair of two sets of relatively movable plates 31 and 32. In the arrangement shown, there is a stationary plate 32 and a relatively movable plate 31 attached to the shaft 20 operated by the movable element, not shown, of the instrument 11. The plates 31 and 32 are arranged to have a variable radius so that, as the shaft 20 is rotated, the spacing between the plates 31 and 32 is varied to vary the capacity between them. This, of course, varies the impedance offered to the current supplied by the source 25'. Electrostatic attraction tends to bring the plates 31 and 32 in the position in which they are closest together, producing a torque M1' which is balanced as in the arrangement of Fig. 1 by the torque M2' produced by an induction disk motor consisting of the induction disk 19 and field coils 33 and 34. There is a condenser 35 in series with the coil 34 in order to produce a phase difference between the currents in the coils 33 and 34. The arrangement of Fig. 3 illustrates a modification of the arrangement shown in Fig. 1 for obtaining a shifting flux for producing rotation of the disk 19.

Preferably, in order to increase the admittance of the variable impedance 29 and thereby increase the relative effect of deflection of the pointer 12, the current source 25' is provided, having greater than the usual commercial frequency, and the measuring apparatus 26' adapted to such frequency is provided which may be calibrated directly in terms of the readings of the pointer 12.

The effect on the spacing of the condenser plates of a deflection of the pointer 12 is represented by showing the pointer and the plate 31 dotted in one scale position and in full lines in another scale position.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention together with the apparatus which I now consider to represent the best embodiment thereof but I desire to have it understood that the apparatus shown and described is only illustrative and that the invention may be carried out by other arrangements.

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

1. In a telemetric system, a sender comprising in combination, a movable indicating pointer, a variable impedance having an exciting winding

and a movable armature mechanically connected to said pointer, and an induction motor unit having an exciting winding and an armature mechanically connected to the movable armature of said variable impedance and acting in opposition thereto, and a source of alternating current energizing said windings.

2. In a telemetric device of the variable impedance type, a variable impedance having an exciting winding and an armature, one of which is movable with respect to the other, and an induction motor unit having a stator and a rotor, one of which carries an exciting winding connected in parallel to the exciting winding of said variable impedance, the rotor being mechanically connected to the movable member of said variable impedance and acting in opposition thereto, the arrangement being such that the forces produced by the reaction between the coacting elements in said variable impedance and by said induction motor unit vary at substantially the same rate with voltage so that the forces remain balanced irrespective of variations in voltage applied to said exciting windings.

3. In a telemetric system, a source of current, a variable impedance supplied by said source and having relatively movable mutually reacting members adapted to have their relative position varied in response to variations in a measurement to be transmitted to vary the impedance correspondingly, and a force-producing movable element producing a force equal at any position to the force produced by the reaction between the relatively movable members of said variable impedance, said movable element being connected to oppose said force of reaction.

4. In a telemetric system of the variable impedance type, a variable impedance having relatively movable mutually reacting members adapted to have their relative positions varied in response to variations in a measurement to be transmitted to vary the impedance correspondingly, and means for balancing the force of reaction between said relatively movable members substantially at any of their relative positions.

5. In a telemetric system of the variable impedance type, a variable impedance having relatively movable mutually reacting members adapted to have their relative positions varied in response to variations in a measurement to be transmitted, means varying in force with the relative positions of said mutually reacting members at the same rate as the reaction for balancing the force of the mutual reaction between said relatively movable members.

6. In a telemetric device of the variable impedance type, a variable inductive impedance having an exciting winding and a vane armature, one of which is movable with respect to the other, the vane armature having a continuously variable cross section to provide variations in reluctance of the flux path of said exciting winding as the relative position of said winding and said armature is varied, and means for balancing at every relative position of said armature and vane the force produced by the tendency of said exciting winding and said vane to seek positions of minimum reluctance with respect to each other.

HERBERT DALLMANN.