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H. DALLMANN
ELECTRICAL INSTRUMENT
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Fig. 1.

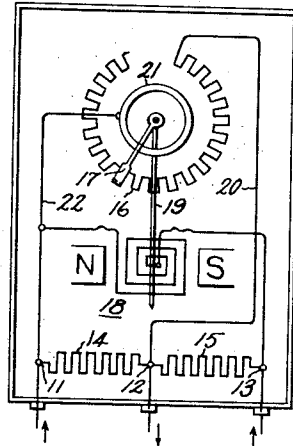


Fig. 2.

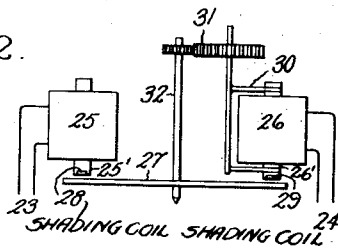


Fig. 4.

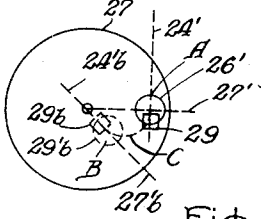
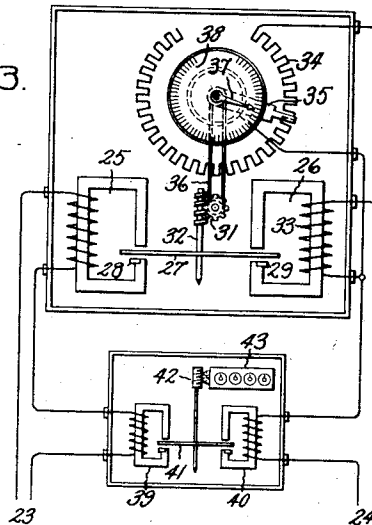


Fig. 3.



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ELECTRICAL INSTRUMENT

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1 Claim. (Cl. 171—95)

My invention relates to electrical instruments and concerns particularly ratio instruments and receivers for telemetering systems of the ratio type.

It is an object of my invention to produce a ratio indicator in which a relatively large angle scale may be employed, if desired exceeding 360°. It is another object of my invention to produce a ratio instrument from which a large torque may be obtained. A further object of my invention is to produce a high torque, large angle receiver for telemetering systems and it is still another object of my invention to provide a telemetering system in which independent indicating and integrating apparatus may be employed without one type of apparatus affecting the operation of the other. Other and further objects and advantages will become apparent as the description proceeds.

In accordance with my invention in its preferred form, I utilize the compensation principle in order to cause the adjustment of one or both of two opposing elements subjected to the currents or voltages to be compared so that unbalance in the elements effects a variation in the adjustment until a balance is obtained.

The features of my invention, which I believe to be novel and patentable, will be pointed out in the claim appended hereto. A better understanding of my invention, itself, however, may be obtained by referring to the following description taken in connection with the accompanying drawing in which Fig. 1 is a diagram representing a resistance type of receiver for telemetering systems in which the magnitude of the quantity to be transmitted determines the ratio of two transmitted currents or voltages; Fig. 2 is a diagrammatic side view illustrating another embodiment of my invention in which the currents to be compared actuate opposing elements cooperating with a movable armature; Fig. 3 is a diagram representing a modified form of the embodiment of Fig. 2, and Fig. 4 is a partial diagram of the arrangement of Fig. 2 presenting a plan view of the movable armature and representing two different positions of one of the opposing elements.

Referring now more in detail to the drawing in which like reference characters are used to designate like parts throughout, in the arrangement shown in Fig. 1, the currents to be compared, which may be either alternating or direct currents, are supplied to the apparatus through terminals 11, 12, and 13. If the apparatus is used as the receiver of a telemetering system, the

system will, obviously, be independent of variations in the strength of the current source since the indications depend upon the ratio rather than upon the strength of the currents or of the voltages of the system.

A resistor 14 is connected between the terminals 11 and 12 and a resistor 15 is connected between the terminals 12 and 13. A rheostat 16, having a movable contact arm 17, is connected in parallel with one of the resistors, for example, the resistor 14, in order to vary the current flowing through the resistor 14 for the purpose of compensation. Resistors 14 and 15 preferably have the same resistance but, if desired, may also be arranged to have different resistances having a fixed relationship to each other. A suitable current responsive device 18 for producing rotary motion in response to current is connected between the terminals 11 and 13. The type of current responsive device 18 to be employed depends on the character of the telemetering system. In the case of an alternating current system, it will obviously be necessary to employ a device responsive to alternating currents. For the sake of illustration, however, I have shown an arrangement applicable to a direct current system in which the current responsive device 18 may take the form of a rotating coil device, such as a d'Arsonval galvanometer or the armature of a direct current motor or ampere hour meter, depending upon the angular range desired in the apparatus.

In the case of a direct current system, the connections are such that the currents enter through two of the terminals 11 and 13 and leave by the common terminal 12 or vice versa. The terminals 11 and 13 will then each carry one of the currents to be compared and the terminal 12 will carry the sum of the currents. This arrangement, therefore, permits the use of a three-wire transmission system, or a two-wire transmission system and a ground, for connecting the transmitting and receiving stations of a telemetering system. The rotatable current responsive element 18 is arranged to control the position of the movable arm 17. If desired, the element 18 may be connected to the movable arm 17 of the rheostat 16 by suitable means such as reduction gearing, belting, linkages, or may also be directly connected by means of a shaft 19, as illustrated for the sake of simplicity, since the particular means for causing the current responsive element 18 to control the position of the movable contact arm 17 does not form a part of my invention.

The connections are such that, when a current flows in the element 18, it tends to move the contact arm 17 in the direction required to cause such a relative variation in the currents in the resistors 14 and 15 that current ceases to flow in the element 18 and the contact arm 17 comes to rest in a position which, obviously, depends upon the ratio of the currents supplied at terminals 11 and 13 and, therefore, serves as an indication of this ratio. If the resistors 14 and 15 have the same resistance, the position of balance will obviously correspond to that in which resistors 14 and 15 carry equal currents so that the voltage drops therein will be equal and the potential difference between the terminals 11 and 13 will be zero. But, as will be readily understood by those skilled in the art, regardless of the relative resistance of the resistors 14 and 15, there will be a predetermined relationship between the currents therein for which the voltage drops will be equal, and the potential difference between terminals 11 and 13 and, consequently, the current in element 18 will be zero. If the ratio between the received currents varies so that a potential difference occurs between the terminals 11 and 13, current will flow in the element 18 and the contact arm 17 will be rotated in the direction required to balance the apparatus.

The current received through terminal 11, obviously, divides into two branches, one flowing directly through resistor 14 to terminal 12, and the other flowing from terminal 11 through conductor 22, stationary ring contact 21, contact arm 17, resistor 16, conductor 20, back to terminal 12. If the apparatus is unbalanced, there will also be a component of current flowing through the element 18 between terminals 11 and 13, which will cause a rotation of the arm 17, variation of the resistance of resistor 16, and the redivision between the branches of the current flowing in resistor 14 and rheostat 16 until the voltage drops in resistors 14 and 15 become equal and the locating arm 17 comes to rest.

In the arrangement illustrated schematically in Fig. 2, the currents to be compared are supplied through two pairs of conductors 23 and 24 to elements 25 and 26 which cooperate with a rotatable element or armature 27. It will be understood that, if desired, in the arrangement of Fig. 2, one of the conductors of each of the conductor pairs 23 and 24 may be connected to a common conductor or to ground in order to permit using the apparatus in a three-wire, or a two-wire and ground system. The elements 25 and 26 may take any desired form depending on the character of the current energizing the system. For example, in the case of alternating current systems, the elements 25 and 26 may take the form of electromagnets having polepieces 25' and 26' provided with shading coils 28 and 29 which cause a rotating or a shifting magnetic field to be produced by each of the elements 25 and 26 in accordance with the well known principle of the induction type of meters and instruments used with alternating currents. The armature 27 may then take the form of a rotatable disc which is acted upon by the rotating fields produced by the elements 25 and 26 and the arrangement is such that the field produced by element 25 tends to produce rotation of disc 27 in one direction and the field produced by element 26 tends to cause a rotation in the opposite direction.

Suitable means are provided for causing the

strength of the reaction between one or both of the elements 25 and 26 and the disc 27 to vary in response to rotation of the disc 27. This may be accomplished by either mechanical or electrical means. One arrangement for accomplishing the result mechanically is shown by way of illustration in Fig. 2. For example, the field producing element 26 may be mounted in a pivoted support or cradle 30 connected by means of gearing 31 to the shaft 32 of the rotating disc 27 so that, as the disc 27 rotates, the element 26 is revolved so as to change its radial distance from the shaft 32 of the disc 27, and also to change the angular relationship between the shading coil 29 and a radius of the disc 27. For example, if the element 26 is swung inward toward the shaft 32, the moment arm of the element 26 about the shaft 32 is reduced, thereby diminishing the torque produced by element 26. Likewise the line 24' (see Fig. 4) joining the center of the polepiece 26' of the element 26 and the center of the shading coil 29 becomes less nearly perpendicular to the radius 27' of the disc 27 extending toward the element 26. In Fig. 4 the induction disk 27 is shown as seen from above and the polepiece 26' is represented in two different positions, the full line representation of the pole 26' in the position A corresponds to the position shown in Fig. 2, and the dotted line representation in the position B illustrates the effect of revolving the element 26 along the arc C. The parts of the polepiece 26' in the position A are designated by the same reference numerals as in Fig. 2, and in position B they are designated by corresponding reference numerals with the suffix b. It will be understood by those skilled in the art that the force produced by the element 26 acts along the line 24' between the centers of the polepiece 26' of element 26 and the shading coil 29, whereas a force tending to produce rotation of disc 27 must act along a perpendicular to the radius 27' of disc 27 through the point of application of the force. In the position B, the line 24'b between the centers of the polepiece 26'b and shading coil 29b is nearly in line with the radius 27'b. Consequently swinging the element 26 inward reduces its torque also by reducing the component of force perpendicular to a radius of the disc 27. It will be observed that the effects of variation in radial distance and of variation in angularity of element 26 are cumulative. The arrangement will obviously be such that the variation in the effect produced by the movement of the element 26 will be such as to bring the elements 25 and 26 into balance and cause the disc 27 to come to rest in an angular position dependent upon the relative strengths of the currents or the voltages supplied through the conductors 23 and 24.

An electrical method for varying the strength of the reaction between the element 26 and the disc 27 is disclosed in Fig. 3. In this arrangement, the winding 33 of the element 26 is shunted by means of a rheostat 34 having a movable contact arm 35 which is mechanically connected by means of a belt 36 and the worm gearing 31 to the shaft 32 of the rotatable disc 27. For convenience in making readings, a pointer or indicator 37 may be mechanically connected to the movable arm 35 so as to cooperate with a scale 38.

The operation of the apparatus shown in Fig. 3 will be readily understood from the drawing and from the explanation of the apparatus disclosed in Figs. 1 and 2. When the current in

the winding 33 is such that the elements 25 and 26 are unbalanced, the disc 27 is caused to rotate in one direction or another until the resistance of the rheostat 34 is sufficiently varied so that the division of current between winding 33 and rheostat 34 and consequently the current in winding 33 is such that the forces produced by elements 25 and 26 are balanced and the pointer 37 comes to rest in a position dependent upon the ratio of the currents or voltages supplied to conductors 23 and 24.

If desired, ratio indicators or telemetric receivers constructed in accordance with my invention may also be used in conjunction with integrating meters or other devices, as shown in Fig. 3. In this arrangement, the induction type torque producing elements 39 and 40 are connected in series with the elements 25 and 26 respectively, and react with a revolving disc 41 connected through gearing 42 to a register 43. The rate of rotation of disc 41 depends upon the ratio of one current to the other or upon the magnitude of the measurement to be transmitted. Consequently, the register 43 serves to integrate the measurements over a time period.

I have herein shown and particularly described certain embodiments of my invention and certain methods of operation embraced therein for the purpose of explaining its principle and showing its application, but it will be obvious to those

skilled in the art that many modifications and variations are possible and I aim therefore to cover all such modifications and variations as fall within the scope of my invention, which is defined in the appended claim.

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

Apparatus responsive to the ratio between two currents comprising a rotatable element composed of current conducting material, a device actuated by one of said currents for producing a resultant shifting magnetic field acting upon said element, a second device actuated by the other of said currents and acting in opposition to said first mentioned device for producing a second resultant shifting magnetic field also acting upon said element, a rheostat connected in parallel to said second mentioned device to divert an adjustable portion of current therefrom, and having a resistance adjusting member mechanically connected to said rotatable element, the connection being such that rotation of said rotatable element varies the resistance of said rheostat in a direction required to divert a sufficient portion of current from said second field producing device to balance the effects of said field producing devices on said rotatable element, whereby the position assumed by said element provides an indication of the ratio between said currents.

HERBERT DALLMANN.