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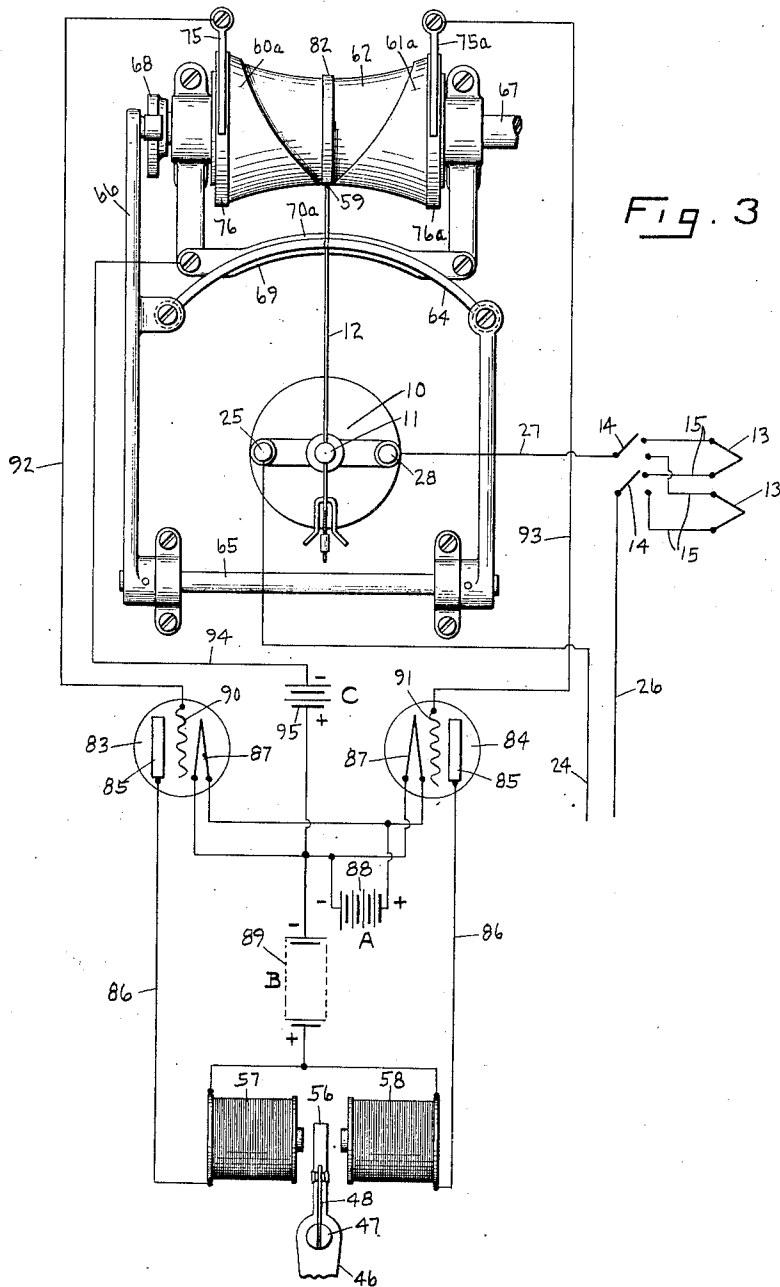
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MEANS FOR INDICATING AND/OR RECORDING UNKNOWN QUANTITIES

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MEANS FOR INDICATING AND/OR RECORD-
ING UNKNOWN QUANTITIESManfred J. Johnson, Naugatuck, Conn., assignor
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This invention relates to means for indicating and/or recording unknown quantities, and in its more specific aspects, to a recording potentiometer.

5 In my copending application Serial No. 517,435, filed February 21, 1931, now Patent No. 1,910,340, dated May 23, 1933, I have disclosed a potentiometer in which the adjustments of the slide wire are quantitatively and directionally controlled, de-
10 pending upon the extent and direction of off-zero movements of the deflector or galvanometer.

The invention described and claimed herein in part consists of improvements on the apparatus described and claimed in my said patent, and in
15 part relates to modifications and changes forming part of the invention described and illustrated in my said patent.

A feature of the present invention is the provision of an indicating and/or recording apparatus in which a single motor supplies the power for
20 operating the contact drum for adjusting the slide wire and for rotating the indicating drum.

In the form of my invention shown in my said patent, the slide wire is operated by a separate
25 motor which rotates only when adjusting the slide wire. Accordingly, the time required to adjust the slide wire is lengthened because of the fact that the motor requires a certain time in accelerating from a standstill.

30 By using a single constantly rotating motor to adjust the slide wire and making the motor effective or operative on the slide wire by means of clutches, the slide wire may be more rapidly adjusted, the motor being fully accelerated at all
35 times.

A further feature of the invention disclosed herein is the provision of a contact drum having a concave cylindrical surface and arranging the
40 deflector operated contact so as to operate within the concavity of the drum. The concavity of the drum corresponds to an arc described about the pivot point of the deflector contact, and thus in all positions of the deflector the same relation to the surface of the drum is maintained. In this
45 way, the length of the contact arm or deflector arm may be substantially shortened and the size of the apparatus reduced.

Another feature of the present invention is the provision of means whereby the current passing
50 between the deflector contact and the drum contact may be reduced to an infinitesimal amount, thereby avoiding the production of arcs when the contacts separate. This is accomplished by providing a slide wire control circuit with a pair of
55 vacuum tubes, one for each direction in which the

slide wire is to be moved, and connecting the grid circuits of the tubes to the contact drum so that when the current is opened between the contact drum and the deflector contact there is zero
60 potential on the grid and the plate circuits of the tubes are therefore in balance and no movement of the slide wire occurs. When one or the other of the grid circuits is closed and negative potential applied to the grid connected to the closing
65 contact, the system is unbalanced and the motor, or electromagnet controlling the operativeness of the motor, is made operative.

Other features and advantages will hereinafter appear.

In the accompanying drawings, which show
70 several forms of my invention—

Figure 1 is a diagrammatic view of the recording potentiometer of the present invention, the means for automatically varying the effect of
75 the counter quantity shown in this figure being that at present preferred.

Fig. 2 is a side view of the galvanometer control switch device shown in Fig. 1.

Fig. 3 is a diagrammatic view showing a modified form of the present invention.
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In the form of the invention shown in the accompanying drawings, the balancing device comprises a galvanometer 10 having an armature 11 and a needle 12 having a normal zero position
85 shown in Fig. 1, from which it may be moved to the right or left when the galvanometer is acted upon by a source of E. M. F. The galvanometer 10 is in a circuit adapted to be connected to one or more thermocouples 13, as, for
90 instance, by a switch 14.

The thermocouples 13 are connected by wires 15 leading to certain apparatus, an unknown quantity in connection with which is to be indicated and recorded, each thermocouple being
95 placed in an apparatus in accordance with the usual or any known manner.

When a thermocouple, or other condition-responsive device, as a resistance thermometer or a manometer, is connected as by the switch 14 to the galvanometer 10, the current from the condition-responsive device or means controlled
100 thereby causes the needle 12 of the galvanometer to deflect in one direction or the other. To indicate the unknown quantity which thus causes the needle to deflect, the recording instruments, such as recording potentiometers, are provided
105 with means for applying a counter and known quantity to the galvanometer to balance the quantity applied thereto by the condition-responsive device, and since the amount of the
110

counter effect is known in advance, the unknown quantity may be indicated or recorded by the amount of known quantity which it was necessary to apply to the galvanometer in order to return the needle to zero position.

As heretofore provided and as herein shown, this counter quantity is derived from a source of E. M. F. 16, being usually in the form of a storage battery, and the effect of the source of E. M. F. 16 on the galvanometer 10 is controlled by a potentiometer slide wire 17, the potential drop across the terminals 18 and 19 of the slide wire 17 being regulated by an auxiliary resistance 20 in comparison with a standard cell or a thermocouple 21, such as described and claimed in my Patent, No. 1,726,182, granted August 27, 1929, by means of a galvanometer 22. The slide wire 17 is engaged intermediate its ends by a shiftable contact 23 connected by a wire 24 to one terminal 25 of the galvanometer while the terminal 18 of the slide wire 17 is connected by a wire 26 to the switch 14 by means of which the system may be connected to one or more of the condition-responsive devices 13, the other side of the switch 14 being connected by a wire 27 to the other terminal 28 of the galvanometer. Thus, when a condition-responsive device 13 is thrown in the circuit by the switch 14, the needle 12 of the galvanometer may deflect either to the right or to the left and it may be returned to its zero position by shifting the contact point 23 relative to the slide wire 17 until a counter quantity is applied to the galvanometer by the source of E. M. F. 16. The resistance of the slide wire 17 being known and the positions of the contact 23 having been calibrated, the condition of the apparatus containing the thermocouple 13 which is in circuit will also be known.

Heretofore it was proposed to mechanically adjust the variable contact 23 under the control of the deflections of the galvanometer needle 12, but, as pointed out in my said patent, this operation was slow in comparison with the speed with which the contact 23 may be adjusted, according to the present invention.

Before proceeding to describe the specific embodiments of the invention herein shown, it should be noted that the various positions of the shiftable contact 23 of the slide wire may be indicated graphically on a cylinder 29 or like device containing a record sheet 30 over which a marking device 31 may travel. As diagrammatically indicated in Fig. 1, this marking device is carried by a belt 32 extending over pulleys 33 so that the marking device 31 will travel parallel with the cylinder and over a pulley 34 connected to a shaft 35 carrying the variable contact 23. The cylinder 29 may be rotated by suitable clockwork mechanism so that the conditions referred to will be recorded graphically over a period of time, portions of which are indicated by previously prepared lines on the record sheet 29. According to the present invention, for reasons which will appear below, it is preferable to rotate the cylinder 29 by a synchronous motor 36 through a suitable train of gearing 37.

In the form of my invention shown in my said patent, the slide wire contact 23 was adjusted by a separate electric reversible motor. In some cases, such an arrangement is desirable. However, as pointed out above, the motor required some time to accelerate and thus decreased the speed at which the slide wire adjustments could be made.

In the form of the invention herein disclosed,

the power for adjusting the slide wire contact 23 is derived from the motor 36 which operates the recording drum 29 as above pointed out. As will be pointed out below, the motor 36 has a pinion 36a meshing with a gear 36b on a shaft 67. The shaft 67 has a pulley 38 carrying a belt 39 leading to a pulley 40 on a drive shaft 41 having loosely mounted thereon combination gear and clutch members 42 and 43 and having between the members 42 and 43 a clutch member 44 splined on the shaft. The clutch member 44 has an annular groove 45 operated by a forked arm 46 pivoted at 47 and the forked arm 46 and clutch 44 are held in neutral position between the members 42 and 43 by a spring 48.

When the clutch member 44 is moved to the right as viewed in Fig. 1, it engages the member 42 which meshes with a gear 49 on a shaft 50 having a worm 51 engaging a worm wheel 52 connected to the shaft 35 carrying the slide wire contact 23 and thus causes the slide wire to move in one direction. When, however, the clutch member 44 is moved to the left, it engages the member 43 which meshes with a reverse gear 53 meshing with a gear 54 on the shaft 50, causing the slide wire contact 23 to be moved in the reverse direction. The shafts 41 and 50 and the reverse gear 53 are mounted in suitable bearings 55.

The upper end of the clutch shifter 46 forms an armature 56 for a pair of electromagnets 57 and 58 and it is by means of these electromagnets that the constantly rotating motor is made operative to cause the slide wire to move in one direction or the other. The movements of the slide wire in one direction or the other are, as pointed out in my said patent, controlled by the off-zero movements of the galvanometer needle 12 and in accordance with the direction of such off-zero movements.

For this purpose, the galvanometer needle 12 is provided with a contact 59 cooperating with contacts 60 and 61 on a drum 62 carried by the shaft 67. The cylindrical surface of the drum is made concave and the degree of concavity thereof corresponds with an arc drawn about the pivot point of the galvanometer needle 12. The contact member 59 of the galvanometer needle is substantially tangential to the cylindrical surface of the drum and contacts thereon but is normally spaced therefrom as shown in Fig. 2, and hence the relation between the contact 59 and the cylindrical surface of the drum remains constant through the entire range of movement of the galvanometer needle. The length of the needle, therefore, may be reduced and the dimensions of the apparatus diminished.

The contact member 59 on the needle 12 as shown in Fig. 2 has a nib 63 normally lying away from the surface of the drum and out of contacting position so that the needle is free to shift under the very feeble torque of the galvanometer. To bring the nib 63 into contacting position, there is provided a boom 64 pivoted on a shaft 65 and having an arm 66 engaging a cam 68 on a shaft 67. During each revolution of the shaft 67, the boom is allowed to fall and depress the galvanometer needle to bring the nib 63 into contacting position with the drum and to lock or hold the galvanometer needle against turning. This locking is effected by reason of an anvil 69 located under the boom 64 and between which and the boom the needle 12 is locked when the boom is depressed.

In my said patent, the contacts 60 and 61 are insulated from each other, thus requiring two

collector rings to directionally control the adjustment of the slide wire. In the present application, however, this is not done. Instead, the contacts 60 and 61 are electrically connected together and the directional control of the device is effected by contacts 70 and 71 lying on the anvil. These contacts 70 and 71 are separated by insulation 72.

Current for controlling the electromagnets 57 and 58 may be supplied from any suitable source as, for instance, a battery 73 and is led therefrom by a wire 74 to a brush 75 engaging a collector ring 76 in permanent electrical connection with the contacts 60 and 61. From the other side of the battery, current flows through a wire 77 to branches 78 and 79 leading to the electromagnets 57 and 58. These are connected respectively by wires 80 and 81 to the contacts 70 and 71.

As in my said patent, the movements of the slide wire contact 23 are controlled quantitatively by the contacts 60 and 61 on the drum, and accordingly these contacts are wider on their outside ends and taper off toward the center of the drum, that is, toward the zero position of the deflector. 12. The other space is made so as not to constitute a contact, in the present invention, by being cut-away, and in such cases at the zero position the drum carries an annulus 82 of insulating material against which the nib 59 may be pressed in the zero position of the needle 12.

If desired, the non-contacting portion of the drum may be produced by enameling or painting the same with insulating material.

When the apparatus is in operation, the deflector 12 is depressed periodically to bring the nib 63 into contacting relation with the drum. If the needle has deflected toward the left as shown in Fig. 1, the nib will be brought into engagement with the contact 60 and the needle itself will be brought into engagement with the directional contact 70. This will close the circuit through the battery 73 and the electromagnet 57, thereby causing the clutch member 44 to engage the member 42 and move the slide wire counter-clockwise. The extent of movement of the slide wire contact 23 will, of course, depend upon the width of the contact 60 at the point at which the deflector engages the same. If the needle 12 is deflected toward the right, the circuit will be closed between the drum contact 61 and the anvil contact 71, thus causing the magnet 58 to be energized and cause the slide wire 23 to be moved clockwise through the shaft 50, reverse gear 53 and clutch member 43.

As in my said patent, the contacts 60 and 61 and the slide wire and mechanical parts operating the same may be so arranged that in a single adjusting operation the system may be balanced, thereby avoiding step-by-step adjustments of the slide wire to bring the circuit into balance and indicate the unknown quantity.

In the form of my invention shown in Fig. 3, the parts now shown therein may be the same as those shown in Fig. 1. In this form, the contacts 60a and 61a are electrically insulated from each other and there is a single anvil contact 70a. The electromagnets 57 and 58 are energized through vacuum tubes 83 and 84. The plates 85 of the vacuum tubes are connected by wires 86 separately to the electromagnets 57 and 58. The filaments 87 are heated by a battery 88 and the plate current is supplied by a battery 89.

The grids 90 and 91 of the vacuum tubes are connected respectively by wires 92 and 93 to brushes 75 and 75a engaging collector rings 76

and 76a connected with the contacts 60a and 61a respectively. The anvil 70a is connected by a wire 94 with a negative bias battery 95.

When the deflector 12 is in zero position and is depressed so as to bring its contact into engagement with the insulating annulus 82, the plate currents in both tubes are balanced, and accordingly the armature 56 of the clutch shifter is held in neutral position. When, however, the deflector 12 moves off zero and is brought into contact with the anvil 70a and one of the contacts 60a or 61a, the grid of the associated vacuum tube is made negative, thus unbalancing the plate circuits and causing the electromagnet 57 or 58 to be energized according to the direction of off-zero movement of the deflector.

With this arrangement, the current flowing between the anvil and the deflector and the deflector and the drum contacts may be infinitesimal. Hence, arcing between the contacts when breaking is prevented and it becomes unimportant whether or not good contact is made between the anvil and the needle and the needle and the drum.

Variations and modifications may be made within the scope of this invention and portions of the improvements may be made without others.

Having thus described the invention, what is claimed as new and for which it is desired to obtain Letters-Patent, is:—

1. An indicating instrument comprising a deflector operating on the zero principle; means for causing an unknown quantity to act on the deflector; means for applying a counter quantity to the deflector; means including a constantly operating electric motor, a gear mechanism and a clutch therefor, electromagnet means controlling the clutch, a contact moved by the deflector in its off-zero movement, a cooperating contact having an effective width increasing in the direction of the first-named contact's off-zero movement, said contacts being relatively movable while in engagement, in the direction of the width of the second-named contact to control the electromagnet and clutch; means controlled by the clutch to quantitatively vary the effect of the counter quantity; and means controlled by the varying means for indicating the unknown quantity.

2. An indicating instrument comprising a deflector operating on the zero principle; means for causing an unknown quantity to act on the deflector; means for applying a counter quantity to the deflector; means for varying the effect of the counter quantity including a constantly operating electric motor, a reverse gear mechanism, a clutch therefor, and electromagnetic means for shifting the clutch in one direction or the other, a contact moved by the deflector in its off-zero movements in either direction and a pair of cooperating contacts each having an effective width increasing from the zero position of the first-named contact in the direction of the latter's off-zero movements, said first-named contact and the pair of cooperating contacts being relatively movable while in engagement, in the direction of the widths of the second-named contacts and the latter being adapted to control the electromagnetic means and the clutch to quantitatively and directionally control the movements of the varying means; and means controlled by the varying means for indicating the unknown quantity.

3. Means for adjusting the slide wire in a potentiometer system having a galvanometer,

- comprising a constant speed electric motor; a variable connection to the slide wire operated by the motor; a control circuit; a contact in the control circuit movable at constant speed by said motor; a contact controlled by the galvanometer adapted to engage the first-named contact intermittently to control said circuit; and means controlled by said circuit for causing said motor to operate said variable connection to the slide wire.
4. Means for adjusting the slide wire in a potentiometer system having a galvanometer, comprising a constant speed electric motor; a variable connection to the slide wire operated by the motor; a control circuit; a pair of contacts in the control circuit movable at constant speed by said motor, one for the controlling operation of said variable connection in each direction; and a contact controlled by the galvanometer adapted to engage either one of the first-named contacts intermittently in its off-zero movements to control said circuit; and means controlled by said circuits for causing said motor to operate said variable connection to the slide wire in one direction or the other depending upon the direction of the off-zero movements of the galvanometer and the particular one of said pair of contacts which it engages.
5. Means for adjusting the slide wire in a potentiometer system having a galvanometer, comprising an electric motor; a variable connection to the slide wire operated by the motor; a motor control circuit including a contact controlled by the galvanometer; a cooperating contact normally incapable of engaging the contact moved by the galvanometer; means operated independently of the galvanometer for causing said contacts to be pressed into firm engagement intermittently including a boom; and an anvil against which the galvanometer contact is moved by the boom, said anvil constituting a contact in said control circuit.
6. Means for adjusting the slide wire in a potentiometer system having a galvanometer, comprising an electric motor; a variable connection to the slide wire operated by the motor; a motor control circuit including a contact controlled by the galvanometer; a cooperating contact normally incapable of engaging the contact moved by the galvanometer; and means operated independently of the galvanometer for causing said contacts to be pressed into firm engagement intermittently, said motor control circuit including a thermionic device, the grid circuit of which is controlled by said cooperating contacts.
7. Means for adjusting the slide wire in a potentiometer system having a galvanometer, comprising an electric motor; a variable connection to the slide wire operated by the motor; a motor control circuit; a drum having a concave contact in the motor control circuit movable at constant speed; a cooperating contact member in the motor control circuit moved by the galvanometer in its off-zero movements and normally out of engagement with the drum or the contacts thereon and having a pivot point concentric with the concavity of said contacts; and means for periodically causing said galvanometer contact member to move into engagement with the drum contacts.
8. Means for adjusting the slide wire in a potentiometer system having a galvanometer, comprising an electric motor; a variable connection to the slide wire operated by the motor; a motor control circuit; a contact in the motor control circuit movable at constant speed; a contact controlled by the galvanometer in its off-zero movements adapted to engage the first-named contact intermittently to cause the motor to operate; and means for holding the galvanometer contact against movement while in engagement with the other contacts, said last-named contact including contacts for directionally controlling the effective operation of the motor.
9. Means for adjusting the slide wire in a potentiometer system having a galvanometer, comprising an electric motor; a variable connection to the slide wire operated by the motor; and means periodically made operative and at each operation causing the motor to move said variable connection a greater or lesser extent in one direction or the other and controlled by the galvanometer in its off-zero movements and depending upon the magnitude and direction of said off-zero movements, said last-named means comprising a pair of thermionic devices, each for controlling one directional movement of the variable connection.
- MANFRED J. JOHNSON.

DISCLAIMER

1,971,313.—*Manfred J. Johnson*, Naugatuck, Conn. MEANS FOR INDICATING AND/OR RECORDING UNKNOWN QUANTITIES. Patent dated August 21, 1934. Disclaimer filed December 9, 1939, by the inventor and the assignee, *The Lewis Engineering Company*.

Hereby enters this disclaimer to claims 6 and 9 of the patent.
[Official Gazette January 2, 1940.]