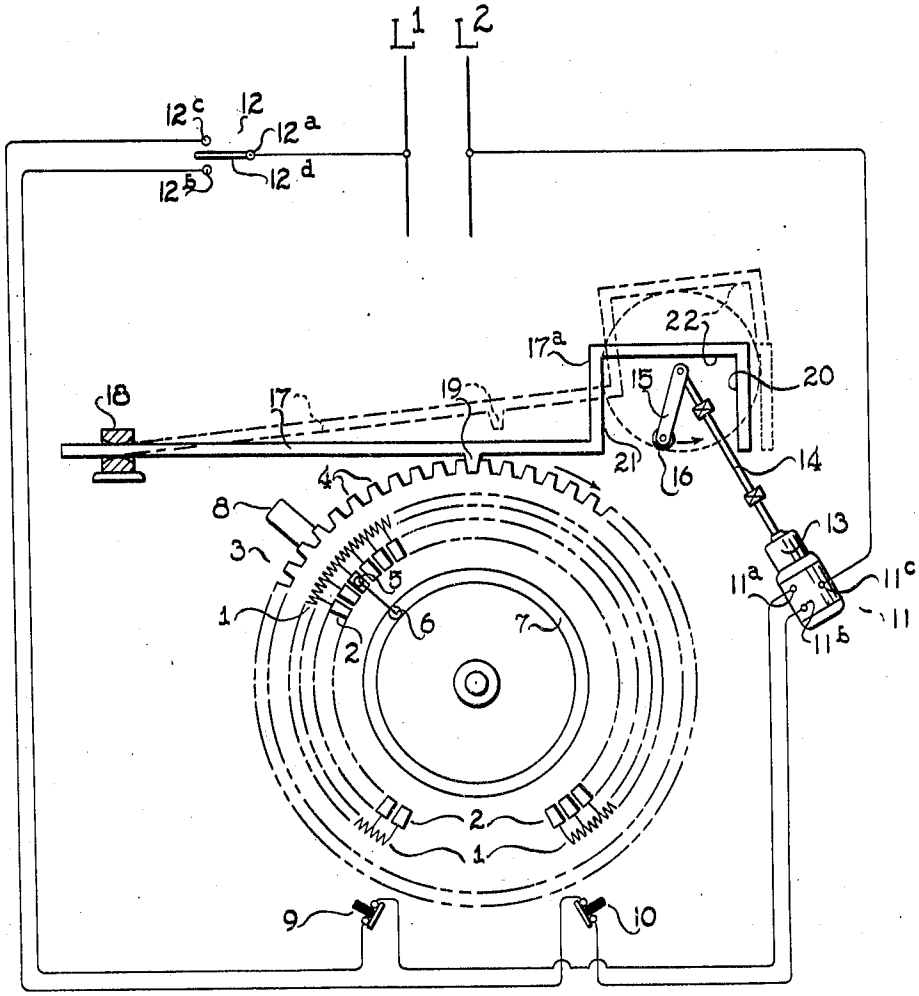
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STEP-BY-STEP OPERATING MECHANISM

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STEP-BY-STEP OPERATING MECHANISM

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This invention relates to a step by step operating mechanism and is especially adapted to the operation of rheostats and the like.

In practice it is frequently required to operate a variable resistance rheostat at a slow rate from a high or maximum resistance position to a low or minimum resistance position, or vice versa. If the rheostat carries a substantial current, it is desirable to move the contacts from point to point throughout the range of operation in a step by step motion, so that the resistance between a movable contact and the stationary contact is during most of the time a minimum, i. e., the respective contacts register with each other. Otherwise the contacts are subject to excessive heating, pitting and wear due to arcing therebetween.

The aforementioned condition is also of importance if the device is an inductance, operating on alternating current. In the latter case the bridging of two or more adjacent stationary contacts by the movable contact brush must be limited in time, in order to avoid overheating of that section of the inductance, which carries the short-circuit current due to such bridging of contacts.

An object of the present invention is to provide an improved step by step drive of the aforementioned character.

Another object is to provide a reversible step by step drive of extremely simple construction.

Another object is to provide a reversible step by step drive actuated by a reversible motor.

Another object is to provide a drive of the aforementioned type in which the direction of movement of the driven member is reversed upon reversal of the driving motor.

Another object is to provide a multiple contact rotary switch in which the movable contact is moved in a step by step motion into and out of engagement with the successive contacts so as to register squarely therewith sequentially.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawing illustrates a preferred embodiment of the invention.

The system illustrated comprises a resistor 1, having a plurality of taps each connected to one of a plurality of contacts 2. The rheostat may be connected into a circuit to be controlled in any well known manner. A pivoted gear wheel 3 is provided at its circumference with gear teeth 4. Contact brushes 5 and 6, respectively, are attached to but insulated from the wheel 3 to rotate therewith, and are conductively connected with each other. The brush 5 is arranged to engage the contacts 2, while the brush 6 makes contact with a stationary contact ring 7, arranged concentric with the wheel 3. The wheel 3 is further provided with an abutment 8 which, upon the brush 5 having been moved into engagement with one or the other of the end contacts 2, according to the direction of rotation of wheel 3, acts to open normally closed stationary limit switches 9 or 10, selectively.

The apparatus further includes a reversible motor 11, having built-in change-speed gearing, as indicated at 13. Motor 11 has reversing terminals 11^a and 11^b and a common terminal 11^c. The motor may be of any desired reversible type and the method of its control forms no part of the present invention. The terminal 11^c is connected to the line L^2 of a current supply L^1, L^2. The line L^1 is connected to the center terminal 12^a of a reversing switch 12, which is provided with stationary contacts 12^b and 12^c selectively engageable by a contact lever 12^d. The contact 12^b is connected through the limit switch 9 to the motor terminal 11^a, and the contact 12^c is connected through limit switch 10 to motor terminal 11^b.

The shaft 14 of motor 11 is mounted in suitable bearings, and is provided with a crank lever 15, the outer end of which carries a roller 16. When the power required to be transmitted by the lever 15 is small; as where rack member and gear wheel of relatively small size are employed, a pin fixed to lever 15 may be substituted for the roller 16. A rack 17 is guided near one end thereof for sliding and oscillatory motion in a suitable bearing 18. Intermediate its length the rack 17 is provided with a gear tooth 19 which is adapted to mesh with the teeth 4 of the wheel 3. A plurality of teeth like 19 may be employed if desired. At its other end the rack 17 is provided with an inverted U-shaped extension 17^a of substantially rectangular contour, the inner surfaces 20, 21 and 22 of the three walls of which are adapted to be engaged by the roller 16 and to act as cam surfaces or a track in conjunction with the latter. The surfaces 20 and 21 are so arranged that, in the lower position of rack 17 illustrated, they are substantially parallel to a line connecting the center of wheel 3 with the point of engagement of the tooth 19. The surfaces 20 and 21 are joined by the transverse surface 22 to form an inverted U. In the embodiment illustrated the distance between the parallel surfaces 20 and 21 is equal to the diameter of the circle described by the circumference of the roller

16 upon rotation of the arm 15, less the desired tangential movement of the teeth 4 for one step of motion, which is usually equal to the circumferential pitch of teeth 4. The surface 22 is so arranged that as an incident to engagement thereof by roller 16 the extension 17a of lever 17 is lifted sufficiently to effect disengagement of the tooth 19 from the teeth 4.

It will be apparent that when the crank lever 15 is rotated counterclockwise, the rack 17 is reciprocated back and forth by the distance of a tooth pitch. During the movement of the rack 17 to the right the tooth 19 is engaged with the wheel 3, and as the lever 15 moves from the position thereof illustrated in a counterclockwise direction the roller engages surface 20 to effect movement of rack 17 toward the right, until the extreme right-hand position of the latter is reached. Thereupon clockwise rotation of the wheel 3 ceases, while the brush 5 rests squarely on one of the contacts 2. The angular pitch of said contacts is equal to the angular pitch of the teeth 4. Shortly after the movement of rack 17 to the right ceases, the roller 16 engages the surface 22 and lifts the rack 17, thereby effecting disengagement of the tooth 19 from the teeth 4. After the lever 15 has passed through its upper vertical position the roller 16 remains for a time in engagement with surface 22, permitting a slight degree of lowering of rack 17. When the roller 16 comes into engagement with surface 21, the tooth 19 still clears the teeth 4. Further rotation of the lever 15, by engagement of roller 16 with said surface 21 effects movement of the rack 17 to its extreme left-hand position, at the same time permitting a further degree of lowering of tooth 19 without engaging the same with teeth 4. Thereafter further rotation of lever 15 permits the tooth 19 to drop abruptly or substantially vertically into the next space between two teeth 4. The operation described is repeated at every revolution of the lever 15.

It will readily be seen that with the parts in the respective full line positions illustrated upon reversal of rotation of the motor 11, the tooth 19 is first lifted out of engagement with teeth 4, then carried to the right and dropped into engagement with teeth 4 one space to the right of the full line position of tooth 19 illustrated; whereupon the rack is moved toward the left to effect counterclockwise movement of wheel 3 to a degree corresponding to the clockwise movement aforementioned. Hence reversal of motor 11 by operation of switch 12 causes corresponding reversal of the step by step movement of rheostat wheel 3.

When the abutment 8 makes contact with either of the limit switches 10 or 9, the cycle of operation of the motor in the corresponding direction is interrupted.

The proportions of the cam surfaces 20, 21 and 22 and the lever 15 may be such, that for each revolution of lever 15 the degree of rotation of the wheel 3 is a multiple of the circumferential pitch of teeth 4. It will also be apparent that the cam surfaces 20, 21 and 22 need not be straight line surfaces as shown, but that they may be suitably curved. It is only necessary that they be correlated to the lever 15 and roller 16 in such a manner that the tooth 19 is in engagement with the wheel 3 for a desired distance and that the rack 17 can move in the reverse direction without interference with the wheel 3.

The specific embodiment of my invention herein disclosed is intended primarily to provide an extremely slow motion rheostat drive; as, for instance, one in which approximately one-half hour is required for full travel of the contactor from one end to the other of the rheostat. Such a rheostat is adapted for use in conjunction with a paper coating machine and will cycle continuously to control the moisture content or humidity of the paper.

In this connection it is to be noted that the construction illustrated lends itself admirably for permitting disconnection of the ratchet lever 17 from the rheostat gear 3 (as by merely manually lifting the former); whereas the rheostat may then be readily reset as by manually moving the abutment 8 or a special manually operable handle (not shown).

The device disclosed is therefore generally useful in systems requiring slow motion of the rheostat but enabling quick resetting of the latter manually or otherwise. Thus the device is of great utility when employed in conjunction with a machine for winding paper, cloth, metal strip, or any other material of web form; wherein the slow motion rheostat will operate to change the field strength of the motor driving the winder, to maintain the proper tension and speed characteristics of the paper strip as the roll diameter builds up. In such an installation the rheostat will preferably be manually reset prior to starting the winding of each new roll.

The step by step operating mechanism herein disclosed is, of course, not limited to use in controlling a single rheostatic circuit. Thus a single mechanism of the character aforedescribed may be utilized to drive two or more rheostats operating in separate circuits. For instance, where two motors are employed to pass a web of cloth back and forth through a dye vat, the motors are respectively adapted to drive rolls onto one of which the web is wound and from the other of which said web is simultaneously unwound. In such an installation, the herein described slow motion mechanism would preferably be arranged to drive the movable elements of two rheostats (arranged on opposite sides of a single gear, such as 3), and said rheostats would be so connected relatively to their associated circuits that the field of one of the motors would be strengthened simultaneously with the weakening of the field of the other motor; so as to maintain the motor torques in proper relationship to the relative thicknesses of the wound material upon the respective rolls, thus enabling maintenance of a substantially constant tension upon the web of material between the rolls during the entire winding and/or unwinding operation. As aforeindicated, the rate of movement of the contactors of the rheostats would be synchronized with the rate of change of diameter of the respective rolls of web material.

I claim:

1. A step by step operating mechanism comprising, in combination, a movable member having gear teeth formed thereon, a rack comprising a single rigid element and supported near one end thereof for combined reciprocatory and transverse movement in the plane of said member and having at least one tooth adapted for cooperation with said gear teeth, a crank, means for continuously rotating said crank, and said rack being provided near its other end with a plurality of track surfaces formed thereon and arranged in the form of an inverted U, said surfaces being sequentially engaged by said crank during each complete rotation of the latter, whereby said combined reciprocatory and trans-

verse movement of said rack is utilized to effect step by step movement of said movable member in a given direction in synchronism with the rotation of said crank.

2. A step by step operating mechanism comprising, in combination, a movable member having gear teeth formed thereon, a rack comprising a single rigid element and supported near one end therefor for combined reciprocatory and transverse movement in the plane of said member and having at least one tooth adapted for cooperation with said gear teeth, a crank, means for continuously rotating said crank, said rack being provided near its other end with a plurality of track surfaces formed thereon and arranged in the form of an inverted U, said surfaces being sequentially engaged by said crank during each complete rotation of the latter, whereby said combined reciprocatory and transverse movement of said rack is utilized to effect step by step movement of said movable member in a given direction in synchronism with the rotation of said crank, and said rack tooth being manually disengageable from said gear teeth at will, to thereby permit movement of said movable member to any desired position subject to manual control, for the purpose set forth.

3. A step by step motion mechanism comprising, in combination, a crank, a rotatable wheel, and a rack comprising a single rigid element and supported near one end thereof for combined reciprocatory and transverse movement in the plane of said wheel and adapted to engage said wheel, said rack being provided near its other end with a track arranged in the form of an inverted U and adapted to be engaged by said crank for causing said rack to intermittently engage said wheel and rotate it step by step in a given direction in synchronism with the rotations of said crank.

4. A step by step motion mechanism comprising, in combination, a crank, a rotatable gear, a rack arranged for combined reciprocatory and transverse movement in the plane of said gear, said rack having a detent adapted to engage said gear, and said rack being further provided with a track arranged in the form of an inverted U and adapted to be engaged by said crank during each rotation of the latter for causing said rack to engage said gear and rotate it through a predetermined angle in a given direction in synchronism with the rotation of said crank.

5. A reversible step by step motion mechanism comprising, in combination, a crank, a gear, a rack comprising a single rigid element, and a fixed support for one end of said rack affording combined reciprocatory and transverse movement of said rack in the plane of said gear, said rack having a detent adapted to engage said gear, and being provided near its other end with a track arranged in the form of an inverted U and adapted to be engaged by said crank for causing said rack to intermittently engage said gear, and move it step by step in a given direction in synchronism with the rotations of said crank, and to reverse the direction of movement of said gear upon reversal of the direction of rotation of said crank.

6. A regulator for controlling an electric circuit comprising, an impedance having a plurality of stationary contacts arranged in side by side relation for varying the amount of said impedance included in an electric circuit, a contactor adapted to complete a circuit with only one of said contacts selectively, a gear operatively connected with said contactor to move the same in a step by step motion from one of said contacts to another selectively, a reversible motor, means for energizing said motor to rotate it in opposite directions selectively, a crank rotated by said motor, a rack comprising a single rigid element and adapted to engage a support at one end thereof, a support for said rack affording combined reciprocatory and transverse movement of said rack in the plane of said gear, said rack having a detent adapted to engage said gear, said rack also being provided with a track arranged in the form of an inverted U and adapted to be engaged by said crank for causing said rack to intermittently engage said gear to rotate said gear step by step in a given direction upon the rotation of said motor, so as to cause said contactor to register with one of the contacts at the end of each step and to reverse the direction of rotation of said gear upon reversal of the direction of rotation of said motor, means to effect deenergization of said motor when said gear reaches its limit of travel in the respective direction, and said rack being manually disengageable under all conditions to render said detent ineffective, whereby said contactor may be reset to any desired position, for the purpose set forth.

7. In an operating mechanism for a circuit commutating device or the like, said device being provided with stationary contacts arranged in side by side relation, and with a contactor adapted to complete a circuit with any one of said contacts selectively, the combination of a gear operatively connected with said contactor to move the same in a step by step motion from one of the contacts of said device to another, a reversible motor, means for energizing said motor to rotate it in opposite directions selectively, a crank rotated by said motor, a rack comprising a single rigid element and adapted to engage a support at one end thereof, a support for said rack affording combined reciprocatory and transverse movement of said rack in the plane of said gear, said rack having a detent adapted to engage said gear, said rack being also provided with a track arranged in the form of an inverted U and adapted to be engaged by said crank for causing said rack to intermittently engage said gear to rotate said gear step by step in a given direction upon the rotation of said motor, so as to move said contactor to register with one of the contacts at the end of each step and to reverse the direction of rotation of said crank upon reversal of the direction of rotation of said motor, and said rack being manually disengageable under all conditions to render said detent ineffective whereby said contactor may be reset to any desired position for the purpose set forth.

JESSE E. JONES.

CERTIFICATE OF CORRECTION.

Patent No. 2,341,182. February 8, 1944.

JESSE E. JONES.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 9, claim 2, strike out "therefor" and insert instead --thereof--; same column, line 43, claim 4, strike out "arranged" and insert instead --comprising a single rigid element and supported near one end thereof--; line 46, same claim, after "provided" insert --near its other end--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 9th day of May, A. D. 1944.

Leslie Frazer

(Seal)

Acting Commissioner of Patents.

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