Jan. 23, 1940. R. W. SCOTT ET AL 2,187,795

CIRCUIT CONTROLLER

Filed April 30, 1937 2 Sheets-Sheet 1

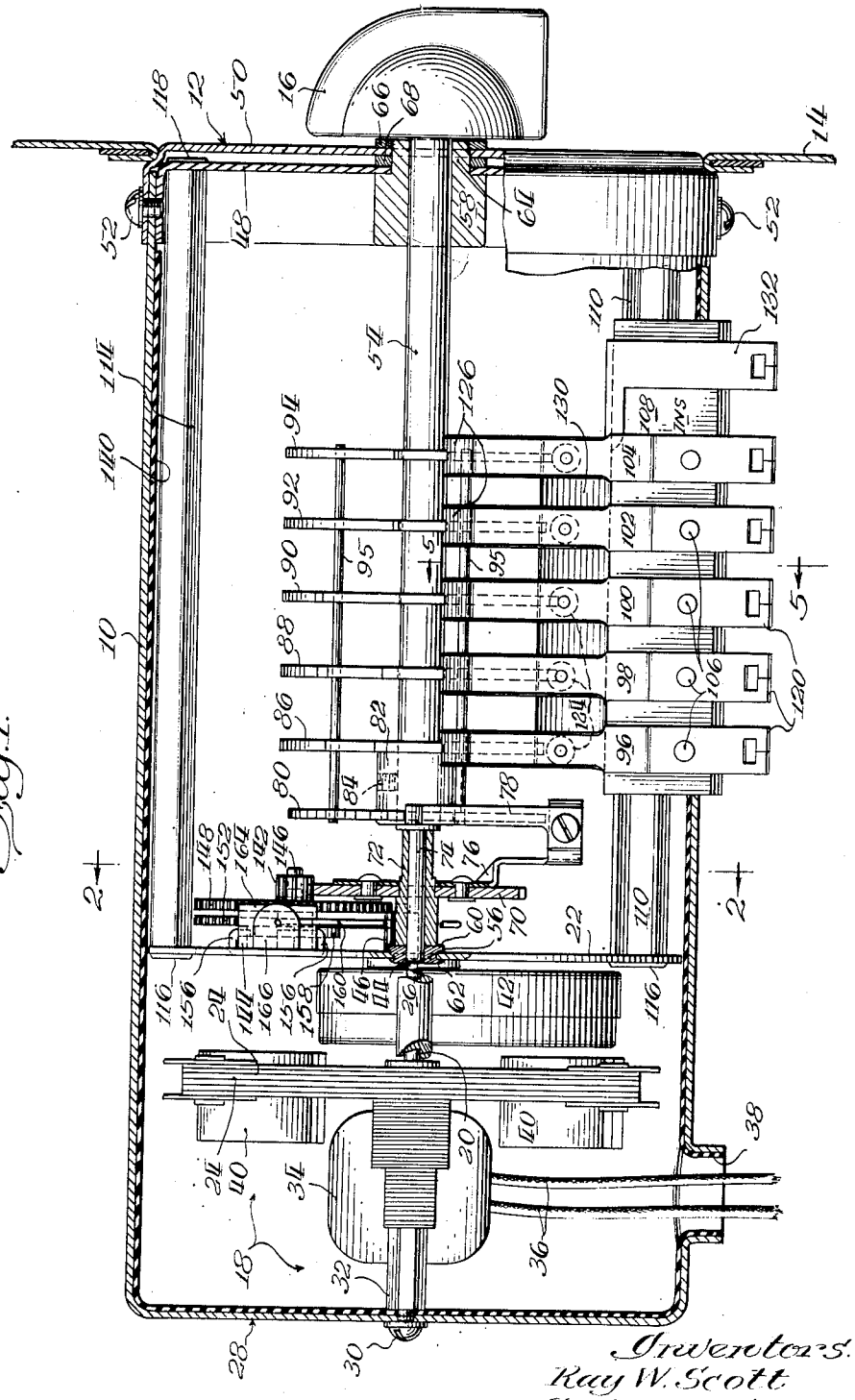

Fig. 1.

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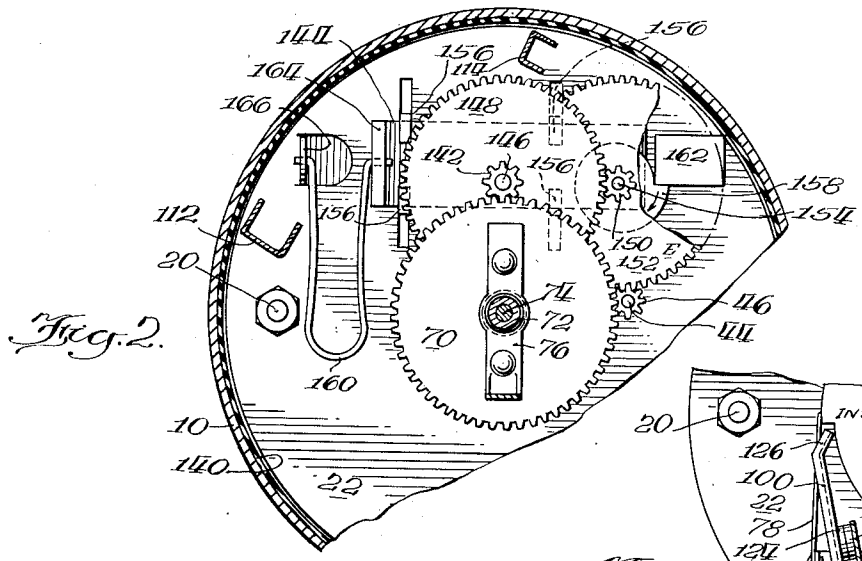

Fig. 2.

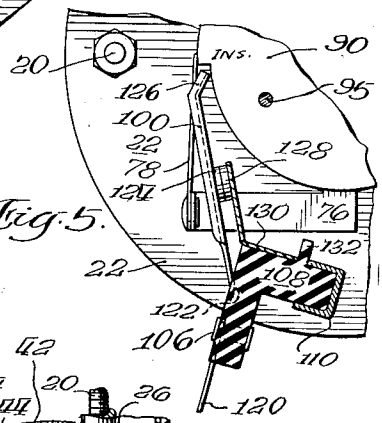

Fig. 5.

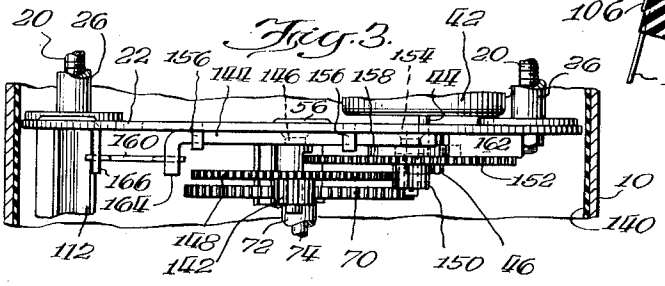

Fig. 3.

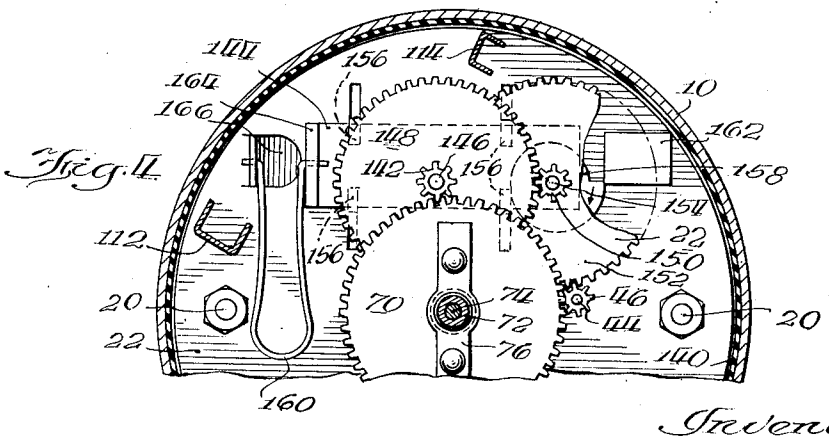

Fig. 4.

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2,187,795

UNITED STATES PATENT OFFICE

2,187,795

CIRCUIT CONTROLLER

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Application April 30, 1937, Serial No. 139,978

15 Claims. (Cl. 200—27)

The present invention relates to circuit controllers, and particularly to rotary circuit controllers of the type rotated in a predetermined direction in periodic steps of uniform length through an escapement mechanism actuated by a constant speed motor.

The primary object of the present invention is to provide a new and improved controller adapted to be rotated positively in periodic steps of predetermined length.

Another object of the present invention is to provide a controller with a new and improved motion-changing mechanism actuated by a constant speed motor and adapted to change the constant speed rotary motion thereof into intermittent uni-directional rotary motion.

A further object of the invention is to provide a new and improved circuit controller rotated intermittently in a single direction through motion-changing mechanism comprising only a few parts, all of which can be economically manufactured and cheaply assembled to form a compact and sturdy controller.

A still further object of the invention is to provide a new and improved controller in which a rotatable element is driven through an actuating mechanism comprising a plurality of gears, to at least one of which both rotary and translatory movement is imparted.

Another object of the invention is to provide a rotary circuit controller of the above type with switch and switch-actuating members that are simple and economical to construct.

In brief, the present invention comprises a pinion driven at constant speed and adapted to drive a gear wheel and pinion mounted coaxially with a single step cam upon a reciprocable carrier. The carrier is biased to move in one direction by suitable spring means and is moved in the opposite direction by rotation of the cam which is maintained in engagement with a fixed abutment by the spring means. The second-mentioned pinion drives a spur gear mounted coaxially with a third pinion upon the carrier. The third pinion in turn drives a spur gear adapted to drive the cam shaft of the controller through a one-way driving connection consisting of a pawl and ratchet mechanism.

Rotation of the driving pinion rotates the cam and since the latter bears against the fixed abutment, movement is imparted in one direction to the reciprocable carrier. During this time rotation is imparted to all the gears, but the cam is constructed with a constant rise so synchronized with the speed of rotation of the gears that the translatory movement imparted to the third pinion is equal to its rotary movement with respect to the third spur gear, whereby the latter remains stationary.

When the high point of the cam falls off the abutment, the carrier is rapidly moved in the opposite direction by the spring. During this movement of the carrier by the spring, the driving pinion being substantially stationary, the third pinion advances the shaft-driving-gear by a direct thrust movement. Accordingly, the cam shaft is turned rapidly and effects both a quick make and break of the circuit-controlling switch members controlled thereby.

A circuit controller constructed according to the present invention is thus rotated positively in periodic steps of constant length. It is exceedingly simple in construction, and requires but a comparatively few parts that may be easily made and quickly assembled. It is also comparatively quiet in operation, and permits the use of a relatively heavy spring to obtain the desired rapidity of movement of the switches.

Other objects of the invention will become apparent from the ensuing description of an embodiment thereof. In the course of this description, reference is had to the following drawings, in which:

Fig. 1 is a side elevation, partially in section, of a controller constructed in accordance with the present invention;

Fig. 2 is a fragmentary transverse vertical section, taken along the line 2—2 of Fig. 1, showing the details of the escapement mechanism in one of its two extreme positions;

Fig. 3 is a fragmentary top plan view of the escapement mechanism;

Fig. 4 is a view similar to Fig. 2, showing the escapement mechanism at the other of its extreme positions; and

Fig. 5 is a fragmentary transverse vertical section, taken along the line 5—5 of Fig. 1, showing the details of the mounting of the cam-actuated switch members.

Referring first to Fig. 1, the circuit controller embodying the present invention may be seen to comprise an elongated, substantially cup-shaped casing 10 and a combined closure and front support 12. The latter extends through an opening formed in the wall 14 of a cabinet or the like surrounding the apparatus to be controlled.

The controller illustrated is adapted particularly for use with washing machines, and is provided with a combined indicating and adjusting knob 16, located outside the cabinet wall, in order

that the user may note the particular function being performed by the apparatus, as well as manually operate the controller to hasten or omit performance of certain functions. It may be mounted with the front end thereof extending through the opening in the cabinet wall, as shown in this figure, in any suitable manner.

The controller may be driven by a constant speed prime mover, such as the self-starting, synchronous motor 18, of conventional construction. The motor is mounted in the rear of casing 10 by a pair of diametrically opposite bolts 20, secured at one end to a substantially circular intermediate support 22, and threaded at their opposite ends into the motor field core 24.

The latter is spaced from the intermediate support by suitable spacing blocks 26 surrounding the bolts (see Fig. 3). The field core is also fastened to the closed rear end 28 of casing 10 by a pair of screw bolts 30, only one of which is shown, extending through suitable apertures in the casing, and surrounded by spacing blocks 32. The core 24 is magnetically energized by a field coil 34 surrounding and supported by a portion of the core. The coil may be supplied with electrical energy through a pair of conductors 36 extending outside the casing through a flanged opening 38 on the under side of the casing.

The motor 18 is made self-starting by providing it with a pair of shading coils 40. The rotor (not shown) drives, through suitable gearing housed within the gear casing 42, a drive shaft 44, extending forward through an opening in the intermediate support, and to the end of which is fixedly secured a pinion 46.

The remaining parts of the circuit controller are supported by the intermediate support 22 and the combined closure and front support 12. The latter consists of a pair of concentrically disposed, cup-shaped members 48 and 50 between the side walls of which the front end of the casing is secured by a plurality of screw bolts 52. The closed ends of members 48 and 50 are spaced apart a slight distance for reasons that will appear shortly.

The main cam shaft 54 of the controller is journalled for rotation in a pair of metallic bearing bushings 56 and 58 mounted centrally of the intermediate and front supports, respectively. The former is provided with an annular collar 60 and a peened-over portion 62, disposed on opposite sides of support 22 for fixedly securing it thereto.

The bearing bushing 58 is provided with a reduced portion 64 extending through apertures in the cup-shaped members 48 and 50. The latter are secured to the reduced portion by a threaded collar 66, and are spaced apart by a washer 68 positioned between them. Intermittent unidirectional rotary movement is imparted to the cam shaft by an escapement mechanism to be described shortly, and comprising a gear wheel 70, pressed upon a hub 72 loosely mounted upon a reduced extension 74 of the cam shaft.

A one way driving connection between the gear wheel and shaft is provided by a pawl and ratchet mechanism, comprising a rigid pawl-carrying arm 76 riveted to the gear wheel, a resilient pawl 78 secured to the outer end thereof, and a metallic ratchet wheel 80 mounted upon the shaft. The ratchet wheel is mounted upon a metallic hub 82, which is fixed to the cam shaft 54 by suitable means, such as the set screw 84.

The circuit controller is provided with a plurality of spaced-apart cams 86, 88, 90, 92 and 94, stamped out of relatively thin sheet insulating material. They are provided with central apertures whereby they may be readily slipped on the shaft, and are secured in fixed, spaced-apart relation for rotation with the cam shaft by a plurality of small-diameter pins 95, forced through aligned openings in the cams and ratchet wheel 80.

The construction of the cam assembly is quite simple, economical, and yet sufficiently sturdy to meet the operating requirements of a controller of the type to which the present invention is directed.

The cams are adapted to actuate resilient contact-carrying switch blades 96, 98, 100, 102, and 104, respectively, secured by rivets 106 to a mounting block 108, formed of insulating material. The mounting block is substantially right angled in cross-section, as may be noted from Fig. 5, and is mounted upon a longitudinal spacer 110 of U-shaped cross-section.

The spacer 110 and similar spacers 112 and 114, spaced at equal distances therefrom, are utilized to secure the intermediate support 22 in fixed, spaced-apart relation to the cup-shaped member 48. The ends of the spacers are peened over, as indicated at 116 and 118, for securing them to the spacers, and from Fig. 1 it may be noted that the peened-over portion 118 fits into the previously described space between the cup-shaped members 48 and 50.

Referring now particularly to Figs. 1 and 5, it may be seen that the switch blades are provided with terminal portions 120 mounted in spaced-apart recesses 122, formed on the supporting surface of the insulating block 108. The major portions of the blades are disposed substantially tangentially to the cams, and have mounted thereon movable contacts 124. The outer free ends of the blades are curved toward the cams, as indicated at 126, and the blades are biased toward the cams and to a position in which the movable contacts 124 are in engagement with the fixed contacts 128, as illustrated in Fig. 5.

The fixed contacts 128 are mounted upon a longitudinally extending contact bar 130, suitably secured to the mounting block 108. The bar 130 is separated from the supporting spacer 110 by a shoulder 132 formed integrally with the mounting block. The bar 130 is also provided with a terminal 132 similar in all respects to the terminals 120 of the switch blades.

The casing 10 may be insulated from the controller by a relatively thin lining 140 of suitable insulating material placed adjacent the inner sides of the casing.

The electrical connections to the various terminals and to the control motor have been omitted from the drawings, but they may take any of the forms well known to those skilled in the art. For instance, the connections may be made after the disclosures contained in the copending applications of Rex Earl Bassett, Jr., Ser. No. 6,425, filed February 14, 1935, Aaron A. Loweke, Ser. No. 78,692, filed May 8, 1936, or of Rex Earl Bassett, Jr. and John W. Chamberlin, Ser. No. 129,429, filed March 6, 1937, the last of which, in particular, contains a complete discussion of washing cycles of the type for which the present controller is specifically designed.

In general, the connections may be such that the terminal 132, and therefore the fixed contacts 128, are connected to one side of a suitable source of supply of electrical energy, and the terminals

of the switch blades to one terminal of each of the control devices. The other terminal of each control device is connected to the other side of the source of supply of electrical energy so that whenever a switch is closed by its associated cam, the control device is energized. Preferably, the control motor 18 is connected in circuit with one of the switches in such manner that once the switches are moved from the "off" position by movement of the cam shaft through the indicating knob, the motor remains energized until the cam shaft is rotated substantially 360 degrees and the cycle of operations has been completed.

The escapement mechanism, through which periodic unidirectional movement is imparted to the cam shaft, is mounted upon the front of the intermediate support 22. It comprises a pinion 142 adapted to engage the gear wheel 70, and to which is imparted both continuous unidirectional rotary movement and reciprocating translatory movement. The rate of rotary movement and of translatory movement in one direction are so synchronized that the gear wheel 70 remains stationary during the time the pinion is moved in this one direction. However, when the pinion is moved in the opposite direction, it is adapted to rotate the gear wheel by a direct thrust.

Continuous rotary movement is imparted to the pinion 142 through a train of gears mounted upon a substantially rectangular carrier 144, and reciprocating translatory movement is imparted to the pinion by mounting the carrier upon the intermediate support for reciprocating movement.

Referring now particularly to Figs. 1 and 2, it may be noted that the pinion 142 is rotatably mounted upon a shaft 146 secured to the carrier 144, and that it is rotated by a spur gear 148 mounted coaxially therewith upon the shaft. The spur gear in turn is rotated by a pinion 150 coaxially mounted with a spur gear 152 upon a second shaft 154, also fixedly mounted upon the carrier. The spur gear 152 is adapted to be engaged by the previously described pinion 46, driven at a constant rate of speed by the control motor 18.

The carrier 144 is mounted for reciprocating translatory movement upon the intermediate support upon four hook-like fingers 156 punched out from the intermediate support. Two fingers are disposed to engage each of the longer sides of the rectangular plate, and thus act as guides, restricting the movement of the plate to a reciprocating movement.

The carrier is moved in opposite directions by a single step cam 158 and suitable spring means, such as the U-shaped spring 160, which is adapted to maintain the cam in engagement with a fixed abutment 162 mounted upon the intermediate support 22. The cam 158 is mounted coaxially with the pinion 150 and the spur gear 152 upon shaft 154, and is thus rotated by the control motor through the pinion 46 and the spur gear 152. As the cam is rotated in the direction of the arrow shown in Fig. 2, the carrier 144 is gradually moved to the left against the bias of the spring, one end of which is mounted upon the transverse projection 164 formed at one end of the carrier, and the other end of which is mounted upon a flanged support 166 suitably secured to the intermediate support.

When the high point of the cam falls off the abutment, the spring moves the carrier in the opposite direction at a rate dependent upon the weight of the spring, which, in order to get a sufficiently rapid opening of the contacts, is made quite heavy.

The carrier is mounted so that its translatory movement is in a path substantially at right angles to a diametral line passing through the axis of rotation of gear wheel 70. The pinion 142 is so located on the carrier that it moves in a path substantially tangential to the gear wheel 70, but remains in engagement therewith at all times, as may be noted from Fig. 4, in which the pinion is shown in its extreme position, away from the gear. The other gears also remain in mesh at all times, as may be noted from the same figure.

In the description of the operation of the circuit controller described above, it will be assumed that the adjusting knob 16 has been manually rotated in a clockwise direction to a "starting" position to energize the control motor 18. Once energized, the motor 18 continues to drive the cam shaft of the controller through the escapement mechanism until the apparatus controlled by the controller performs a complete cycle of operations, and upon the completion of which the control motor 18 de-energizes itself by operation of its associated control switch to a circuit-breaking position. Assuming that the motor 18 is energized at the instant the cam 158 is in the position shown in Fig. 2, then the carrier 144 will be at its extreme right position. The motor 18 imparts rotation at a desired rate to the pinion 146, and the latter in turn rotates the spur gear 152. The latter, being fixedly secured to the pinion 150 and the cam 158, imparts rotation to the latter. At the same time, cam 158, being maintained in engagement with the abutment 162, gradually forces the carrier and the gears rotatably mounted thereon, to the left against the bias of the spring 160. Thus a continuous unidirectional rotary movement and a translatory movement in one direction is imparted to the pinion 146, which is in cooperative relationship with the gear wheel 70.

The rotary motion is imparted to the pinion 146 through the spur gear 148, which is in engagement with the pinion 154, and the translatory movement is imparted thereto by movement of the carrier upon which the shaft 146 is fixedly mounted. By designing the cam 158 and the gear wheels in a well known manner, the rates of the rotary and translatory movement imparted to the pinion 142 are so synchronized that the gear wheel 70 remains stationary.

When the cam 150 has been rotated into the position shown in Fig. 4, the carrier and the elements mounted thereon have been shifted to their extreme left position. Shortly thereafter, upon a continued rotation of the cam 158 through the pinion 46 and spur gear 152, the high point of the cam falls off the abutment 162 and the spring 160 rapidly forces the carrier and the elements carried thereby into the position shown in Fig. 2. Since the pinion 46 remains substantially stationary during the short interval of time that it takes for the spring 160 to force the carrier to the right into the position shown in Fig. 2, the gear wheel 70 is turned in a clockwise direction by direct thrust imparted thereto by the pinion 142.

The gear wheel 70, being connected to the ratchet wheel 80 through the pawl 78 and its mounting arm 76, imparts movement to the shaft as it is rotated. Thus, continued operation of the motor results in the periodic rotation of the cam shaft in the manner described above.

If during the operation of the apparatus being under control of the circuit controller, the operator desires either to hasten or omit performance

of certain functions, the cam shaft 54 may be rotated through the indicating and adjusting knob 16. The cam shaft can be rotated only in a clockwise direction for the reason that the driving motor, acting through the gears and the pawl 78, prevents rotation thereof in the opposite direction.

From the above-described operation of the controller, it may be noted that by constructing the spring 160 of considerable weight the cam shaft may be rotated with a very rapid movement. Furthermore, while the movement imparted to the cam shaft is rapid, there is no danger of causing an "over running" of the controller for the reason that the gears, being in mesh, and the gear 46 being positively rotated, the impulse transmitted to the gear wheel 70 cannot effect rotation of the motor-driven pinion 46. Therefore, the cam shaft is rotated only a predetermined distance upon each actuation of the escapement mechanism.

The construction of the circuit controller may be modified to meet the requirements of the various types of apparatus that may be controlled thereby, and also to meet the various speeds of operation of apparatus.

When the controller is utilized in the control of washing machines, the pinion 46 may be constructed of eight teeth, and driven at a rate of eight revolutions per minute. The spur gears 148 and 152 may be constructed with sixty-four teeth, and the pinions 142 and 150 with eight teeth, whereby the pinion 142 is rotated at a rate of one eighth revolution per minute. The gear wheel 70 is constructed with fifty-six teeth, and is therefore rotated at a rate of one fifty-sixth revolution per minute. Thus it takes the controller fifty-six minutes to complete one cycle of operations.

The above-described constants of the various gears may, of course, be changed as desired, to meet the requirements of practice under different operating conditions.

We claim:

1. In apparatus of the type described, the combination including a controller, means including a gear operatively connected to said controller operable to impart movement thereto, and means including a continuously rotating pinion meshing with said gear and having both rotary and translatory movement, and mechanism for causing the pinion at predetermined intervals alternately to roll around the periphery of the gear without turning the gear and then to move bodily to turn the gear through part of a revolution, for intermittently actuating said gear.

2. In apparatus of the type described, the combination including a rotatable controller, means including a gear secured to said controller operable to impart movement thereto, means comprising a continuously rotating pinion meshing with said gear and cooperatively associated with said last mentioned means and having both rotary and translatory movement, and mechanism for causing the pinion at predetermined intervals alternately to roll around the periphery of the gear without turning the gear and then to move bodily to turn the gear through part of a revolution, for periodically rotating said gear a predetermined distance.

3. In apparatus of the type described, the combination including a rotatable controller, means provided with projecting portions operable to impart movement to said controller, a member having complementary projecting portions adapted to engage said first mentioned projections, and means operable to impart continuous rotary movement in a predetermined direction and reciprocating translatory movement to said member at rates so synchronized that the first mentioned means remains stationary upon translatory movement in one direction and is moved upon translatory movement in the opposite direction for intermittently rotating said controller.

4. In apparatus of the type described, the combination including a rotatable controller, means including a rotatable gear wheel for rotating said controller, a pinion adapted to engage said wheel, and means operable to impart continuous rotary movement in a predetermined direction and reciprocating translatory movement to said pinion at rates so synchronized that the wheel remains stationary upon translatory movement in one direction and is moved upon translatory movement in the opposite direction for intermittently rotating said wheel.

5. In apparatus of the type described, the combination including a rotatable controller, means including a rotatable gear wheel for rotating said controller, a pinion adapted to engage said wheel, gear means for imparting continuous rotary movement in a predetermined direction to said pinion, constant speed means for driving said gear means, and means driven by said constant speed means for imparting a reciprocating translatory movement to said pinion, the rotary and translatory movements being so synchronized that when said pinion is moved in one direction no movement is imparted to said gear wheel and when moved in the opposite direction the gear wheel is rotated thereby.

6. In apparatus of the type described, the combination including a rotatable controller, means including a rotatable gear wheel for rotating said controller, a pinion adapted to engage said wheel, means including a constant speed motor and a cam driven thereby for imparting continuous rotary movement and translatory movement in a predetermined direction to said pinion, the rates of rotary and translatory movement being so synchronized that the gear wheel remains stationary during said translatory movement, and spring means adapted to impart translatory movement in the opposite direction to said pinion for rotating said gear wheel.

7. In apparatus of the type described, the combination including a rotatable controller, means including a rotatable gear wheel for rotating said controller, a pinion adapted to engage said wheel, a reciprocable carrier mounting said pinion, means including a constant speed motor for imparting continuous unidirectional rotary movement to said pinion, means including a cam driven by said motor for moving said carrier in a predetermined direction, spring means for moving said carrier in the opposite direction, said cam and said means for imparting rotary movement to said pinion being so constructed and arranged that when the carrier is moved in said predetermined direction by said cam the gear wheel remains stationary and when the carrier is moved in the opposite direction by said spring means said pinion rotates said gear wheel.

8. In apparatus of the type described, the combination including a rotatable controller, means including a rotatable gear wheel for rotating said controller, a pinion adapted to engage said wheel, a reciprocable carrier mounting said pinion,

means including a motor for imparting unidirectional rotary movement to said pinion, means including a cam mounted on said carrier and driven by said motor, a fixed abutment engageable by said cam and a spring biasing said carrier toward said abutment for moving said carrier in opposite directions, whereby both rotary and reciprocating translatory movement are imparted to said pinion and intermittent rotary movement to said gear wheel.

9. In apparatus of the type described, the combination including a fixed support, a controller rotatably mounted on said support, a gear wheel operable to rotate said controller, a pinion adapted to engage said wheel, a reciprocable carrier mounting said pinion, means including a motor for imparting unidirectional rotary movement to said pinion, means including a cam mounted on said carrier and driven by said motor, an abutment fixedly mounted upon said support and engageable by said cam and a spring biasing said carrier toward said abutment for moving said carrier in opposite directions, whereby both rotary and reciprocating translatory movement are imparted to said pinion and intermittent rotary movement to said gear wheel.

10. In combination, a fixed support, a controller rotatably mounted on said support, a gear wheel operable to rotate said controller, a pinion adapted to engage said wheel, a carrier mounting said pinion and mounted for reciprocating movement upon said support, means including a motor for imparting unidirectional rotary movement to said pinion, and means including a cam rotatably mounted on said carrier and driven by said motor, a fixed abutment on said support adapted to be engaged by said cam and a spring biasing said carrier toward said abutment for reciprocating said carrier, whereby both rotary and reciprocating translatory movement are imparted to said pinion to impart intermittent rotary movement to said gear wheel.

11. In combination, a pair of supports, a controller comprising a cam shaft journaled for rotation in said supports, means including a gear wheel rotatably mounted on said shaft for rotating said shaft, a pinion adapted to engage said gear wheel, a carrier mounting said pinion and mounted for reciprocating movement upon one of said supports, means including a motor and a plurality of gears mounted upon said carrier for imparting unidirectional rotary movement to said pinion, and means including a cam mounted upon said carrier and rotated through certain of said gears mounted upon the carrier, a fixed abutment upon said support and a spring secured at one end to said support and at the other end to said carrier for imparting reciprocating translatory movement to said carrier, whereby both rotary and reciprocating translatory movement are imparted to said pinion to impart intermittent rotary movement to said shaft through said gear wheel.

12. In combination, a pair of supports, a controller comprising a cam shaft journaled for rotation in said supports, means including a gear wheel rotatably mounted upon said shaft and a one-way driving connection therebetween and the shaft for rotating said shaft, a pinion adapted to engage said gear wheel, a carrier mounting said pinion and mounted for reciprocating movement upon one of said supports, means including a constant speed motor and a plurality of gears mounted upon said carrier for imparting unidirectional movement to said pinion, means including a single step cam mounted upon said carrier and rotated through certain of said gears, a fixed abutment upon said support and a spring secured at one end to said support and at the other to said carrier for imparting reciprocating translatory movement to said carrier, whereby both rotary and reciprocating movement are imparted to said pinion to impart intermittent unidirectional rotary movement to said shaft through said gear wheel and one-way driving connection, and manually operable means acting directly upon said shaft for rotating said shaft, said one-way driving connection restricting manual movement of said shaft to one direction.

13. In combination, means mounted for rotary movement, means including a rotatable gear wheel operable to rotate said first mentioned means, a pinion adapted to engage said wheel, a reciprocable carrier mounting said pinion, means including a constant speed motor, a cam driven thereby and resilient means biasing said carrier toward said cam for imparting continuous rotary and reciprocating translatory movement to said pinion, said rotary movement and translatory movement by the cam being so synchronized that the gear wheel remains stationary during movement of said carrier by the cam and is rotated upon movement of said carrier in the opposite direction by said resilient means.

14. In a sequential controller the combination, including a pair of supports, a controller comprising a shaft and a plurality of spaced apart cams mounted thereon journalled for rotation in said supports, switch means mounted upon said supports adapted to be actuated by said cams, means including a gear wheel rotatably mounted upon said shaft and a one-way driving connection therebetween and the shaft for rotating said shaft, a pinion adapted to engage said gear wheel, a carrier mounting said pinion and mounted for reciprocating movement upon one of said supports, means including a constant speed motor and a plurality of gears mounted upon said carrier for imparting unidirectional movement to said pinion, means including a single step cam mounted upon said carrier and rotated at a relatively slow rate through certain of said gears, a fixed abutment upon said support and spring means secured to said support and carrier for imparting translatory movement to said carrier, whereby said carrier is moved at a slow rate in one direction by said cam and at a rapid rate in the other direction by said spring to impart unidirectional intermittent rapid movement to said switch actuating cams through said pinion, gear wheel and one-way driving connection, and manually operable means for manually rotating said shaft whereby said switches may be actuated as desired.

15. In a controller, the combination including, a pair of supports, a plurality of spacers for maintaining said supports in spaced apart relation, a shaft journaled for rotation on said supports, a ratchet wheel secured to said shaft, a gear wheel loosely mounted upon said shaft, a resilient pawl for operatively connecting said gear wheel to said ratchet wheel, a pinion adapted to engage said gear wheel, a carrier for said pinion mounted for reciprocating movement upon one of said supports, means including a constant speed motor and a plurality of gears mounted upon said carrier for imparting unidirectional movement to said pinion, means including a

fixed abutment on said support, a single step cam mounted upon said carrier and rotated by certain of said gears and spring means biasing said cam toward said abutment for imparting reciprocating translatory movement to said carrier, a plurality of cams mounted upon said shaft and secured for rotation in spaced apart relation thereon by a plurality of pins extending therethrough and the ratchet wheel, an insulating block mounted upon one of said spacers, resilient switch blades mounted thereon projecting into the path of movement of said cams, and substantially rigid contacts mounted on said block engageable by said switch blades, the rates of the rotary movement of said pinion and the translatory movement imparted thereto by said single step cam and carrier being so synchronized that the cam shaft remains stationary during movement of the carrier and pinion by the cam and is actuated rapidly when the pinion and carrier are moved in the opposite direction by the spring means.

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