Dec. 3, 1957 F. A. PEARSON ET AL 2,815,410

AUTOMATIC SWITCH CONTROLLERS

Filed April 8, 1954 2 Sheets-Sheet 1

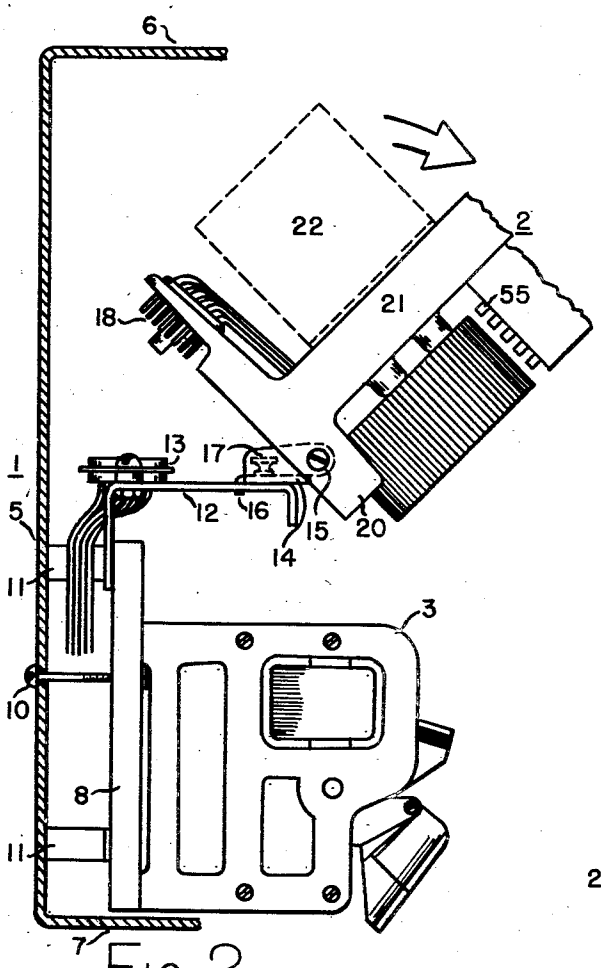


FIG. 2

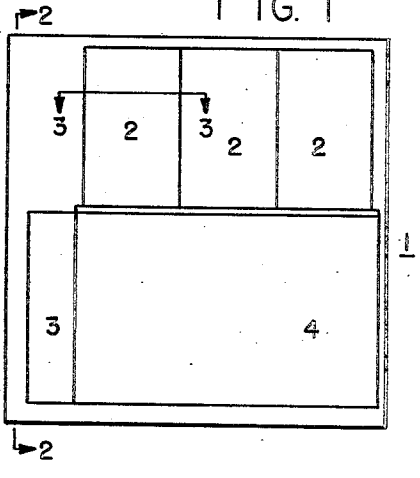


FIG. 1

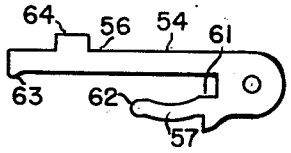


FIG. 11

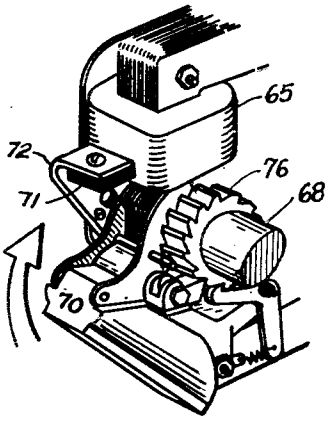


FIG. 5

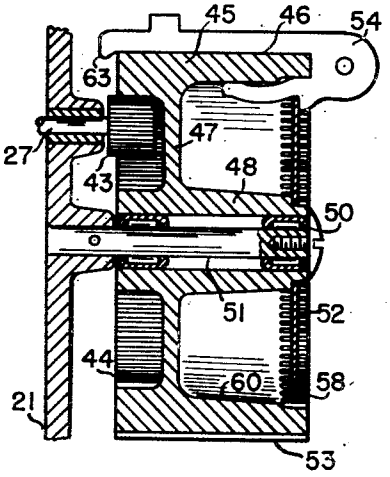


FIG. 10

INVENTORS
FRANK ARTHUR PEARSON
CLARENCE R. SCHWIETERS
GEORGE LELAND RAMBO

By Bruno C. Lechner
Attorney

Dec. 3, 1957 F. A. PEARSON ET AL 2,815,410

AUTOMATIC SWITCH CONTROLLERS

Filed April 8, 1954 2 Sheets-Sheet 2

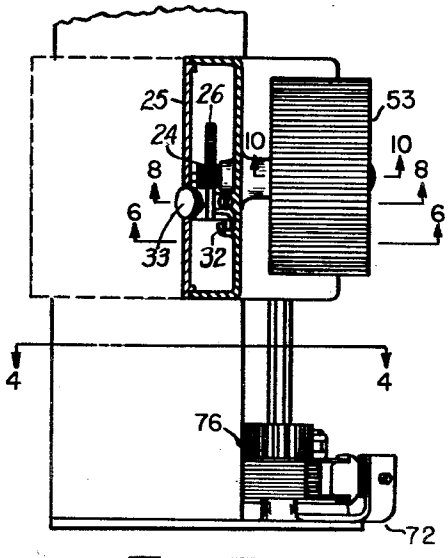


FIG. 3

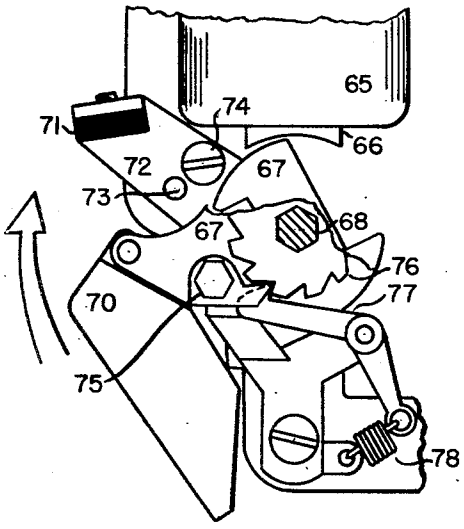


FIG. 4

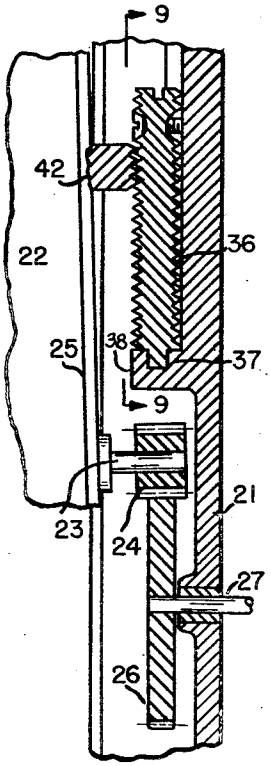


FIG. 8

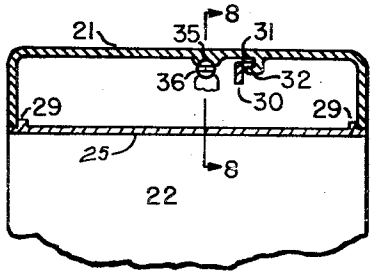


FIG. 7

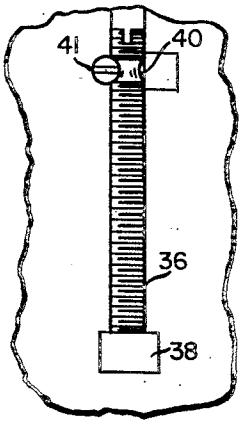


FIG. 9

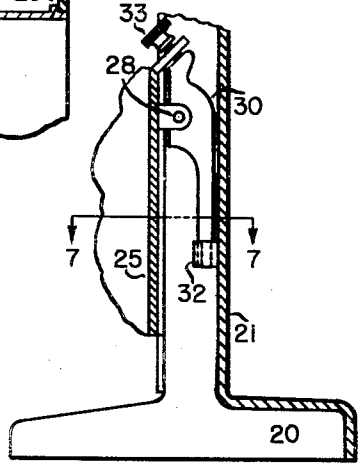


FIG. 6

INVENTORS
FRANK ARTHUR PEARSON
CLARENCE R. SCHWIETERS
GEORGE LELAND RAMBO
By Bruno C. Lechler
Attorney

United States Patent Office

2,815,410

Patented Dec. 3, 1957

2,815,410

AUTOMATIC SWITCH CONTROLLERS

Frank Arthur Pearson, Moline, Ill., Clarence R. Schwieters, Davenport, Iowa, and George Leland Rambo, Moline, Ill., assignors to Eagle Signal Corporation, Moline, Ill., a corporation of Massachusetts

Application April 8, 1954, Serial No. 421,834

8 Claims. (Cl. 200—38)

The invention relates to improved automatic controllers of the type comprising several motor-driven timing devices any one of which is adapted to control the operation of a number of power actuated apparatuses. The controller causes these apparatuses to operate repetitively according to some set pattern which is different for each timing device. By way of illustration but not by way of limitation, such automatic controllers may be employed to change traffic lights at a given street intersection from green to amber and to red at preset time intervals.

Such controllers have a cabinet which houses one or more synchronous motor-driven units, any one of which is adapted to operate, while the other units are at rest, to produce a definite pattern of operation of the lights or other circuits controlled differing from the patterns that the other units would produce.

In the improved automatic controller all the mechanism is mounted in a housing placed inside of the cabinet. Each of these synchronous motor-driven units consists of two sections that are rigidly clamped to each other while the unit is in operation. The first of these sections includes the synchronous motor and the section terminates in a motor pinion which the motor drives at a fixed speed. The second section contains a number of switches, a drum that makes one revolution while a pattern of operation is completed, and dial keys that can be adjusted around the rim of the drum to actuate said switches respectively. The drum is driven by a shaft carried by this second section which carries a gear which meshes with the motor pinion of the first section when the two sections are clamped together.

The drum imposes no appreciable load on the pinion until one of the dial keys encounters a switch-actuating lever. To secure the minimum backlash when the dial key engages a switch-actuating lever, the drum is rotatably supported on a stationary stud and the drum is provided with an internal gear that meshes with a pinion carried by the same shaft that carries the gear that is driven by the motor pinion on the first section.

Since the motor pinion turns at one fixed speed, to change the time required for the drum to make one revolution, the gear that meshes with the motor pinion must be changed. Since changing the gear size will change the distance between the gear shaft and the pinion shaft, the two sections of the motor-driven unit must be clamped together in a somewhat different position relative to each other for each gear size that may be used.

Since such controllers must function under varying weather and temperature conditions with a minimum of maintenance it is important that the gear and pinion mesh with proper, but not excessive, clearance. Lack of clearance between the teeth may cause the small synchronous motor to stall. The invention provides that the operator changing gears need but bring the gears into close contact and then the act of clamping will automatically move the two gears apart the amount of clearance called for by the amount for which the unit has been adjusted at the factory.

Since the switches in the unit and also the driving motor are connected to a number of circuits through a plug carried by the housing when the unit is in operating position, the removal of the unit from the housing and the removal of this plug from the socket should be associated.

The invention provides a shelf in the housing on which one or more of these units are mounted.

Each unit is hinged to the front end of a plate that fits into aligning slots in the shelf. The plate can only be detached from the shelf after the unit has been tilted forward about the hinge on the plate and a thumb nut, revealed by thus tilting the unit, released.

The plug through which all the circuits leading into the unit pass is mounted toward the rear of the unit and the socket is set vertically in the shelf. Therefore, as soon as the unit is tilted all its circuits are disconnected.

Once the unit has been tilted forward, a clamp that holds the two sections of the unit together becomes accessible.

The clamps that holds the two sections of the unit together may now be released. The first section, containing the synchronous motor, may be replaced by a similar section if the motor is not functioning properly. If the length of the cycle is to be changed, the gear on the second unit is changed, the two sections brought together with the teeth of the pinion and the gear in contact. Novel means cause the act of clamping the two sections to move the two sections a small distance relative to each other. This small distance is just enough to afford the desired clearance between the teeth.

The particular unit in use at a given time actuates the switches that control the circuits leading out to power actuated devices by bringing the dial keys carried by a drum into contact with switch arms as the drum revolves slowly.

This drum carries spaced shallow longitudinal grooves on its surface. Dial keys may be slipped into the selected ones of these grooves.

The relative positions of the keys in the slots of the drum determines the intervals between the closing of various circuits.

It is convenient to manufacture the drum with slots wider than the key is thick. To enable the keys to stand out radially even though mounted in shallow grooves, a U-shaped key is used. This has a long and a short leg. The short leg extends into the inside of the drum and engages an inner groove. This inner groove is at the upper rim of an inner conical recess of the drum with the inner and the outer grooves radially aligned.

The inner, shorter leg is about half as long as the outer leg. As the inner leg slides down into the conical recess the long outer leg of the key is drawn firmly against the bottom of the shallow groove on the outer surface of the drum.

The end of the longer leg of the key extends beyond the far end of the drum and carries a small inwardly extending projection. Thus a positive pull on the key is required to spring the legs of the key apart enough to allow this inwardly extending projection to pass over the outer surface of the drum. This projection prevents keys from accidentally slipping out of place.

When the synchronous motor-driven unit carries the finger on the drum into contact with a switch arm, a circuit is closed that energizes a stepper that turns a shaft through a fixed angle each time it is energized. When the shaft has made one complete turn, it has completed one or a multiple of the timed cycles. It is obvious that if the number of steps in a cycle are altered the angle through which the shaft is to be turned is also changed.

Thus, if the change of pattern involves six steps, the shaft is to be moved 60 degrees but if it involves eight steps 45 degrees each time. The invention provides a convenient means of adjusting the stepper to move precisely the selected angle each time that forms a simple fraction of a complete revolution.

The object of the invention is to provide an automatic controller having synchronous motor-driven units that can be removed horizontally from the housing.

A further object is to provide such a controller having units that can be tilted to electrically disconnect the unit for inspection.

A further object is to provide such a unit that can be completely removed from a housing after it is tilted on a plate that can only be released from a supporting shelf by releasing a safety device that is not accessible until after the unit has been tilted.

A further object is to provide a removable unit in a controller having two sections that may be fastened to each other by a single clamp carried by one section which engages a lug on the other section when the sections are slid relative to each other and which, in its final position, draws substantially central portions of the two sections together.

A further object of the invention is to provide a stepper responsive to synchronous motor-driven units that can readily be adjusted to turn a shaft through any one of several arcs at each actuation.

A further object is to provide a unit having two sections that may be fastened to each other by engaging a clamping device carried by one section with the other, then bringing the gear on one section into mesh with the pinion on the other section and which, in the act of fastening, cause the sections to move relative to each other enough to give the desired clearance between the teeth of pinion and gear.

A further object is to provide a drum having equally spaced external grooves, a conical recess in the center, and U shaped keys fitting both into one of said grooves and into the central recess.

Figure 1 shows diagrammatically in elevation a housing containing a panel which carries the mechanism that controls the circuits to traffic lights and a number of control units.

Figure 2 shows to a larger scale, a section along lines 2—2 in Figure 1. This shows a vertical section of the housing with one of the control units tilted for inspection and mounted on a shelf carried by the control panel.

Figure 3 shows a plan view, taken along 3—3 in Figure 1, partly in section, of one of the units shown in Figure 2 after it has been swung back into its operating position, partly broken away, to show the manner in which the two sections of the unit are connected with each other.

Figure 4 is a vertical section taken along 4—4 in Figure 3 and drawn to a larger scale showing an armature rotated by a coil and the ratchet wheel and the pawl moved by it.

Figure 5 is a perspective view of the parts shown in Figure 4.

Figure 6, a vertical section along lines 6—6, in Figure 3, shows in detail the clamping device that clamps the two sections of the control unit together.

Figure 7 is a horizontal section taken along lines 7—7 in Figure 6 showing the clamp and the device that provides the proper clearance between gear and pinion.

Figure 8 a vertical section taken along lines 8—8 shown in both Figures 3 and 7 shows the device that provides clearance between the two sections of the control unit.

Figure 9 shows in elevation this same device taken along lines 9—9 in Figure 8.

Figure 10 is a section through the drum taken along lines 10—10 in Figure 3 which shows the fingers through which the movement of the drum closes switches.

Figure 11 shows one of the fingers in detail.

In the embodiment of the invention shown here, 1 indicates diagrammatically a housing containing the devices which constitute the controller. This housing contains a number of timing units 2, a stepper 3 actuated by current which may be provided by any one of these timing units, and a switching device 4 moved by the stepping device to make and break the connections that set up the circuits that are controlled by the controller.

These devices contained in the housing are more fully shown in Figure 2. The housing has a back 5, a top 6, and a bottom 7. A panel 8 is supported on the back 5 of the housing by a single screw 10 that draws the panel against spacers 11 attached to the back wall 5. This panel supports all of the timing units 2 shown in Figure 1. Thus the entire contents of the housing can be removed by loosening the single screw 10.

The switching device 4, not shown in detail, is of the conventional type in which cams carried by a shaft will, in any particular position of the shaft, hold certain switches closed. Thus, when applied to control of traffic lights in one position the switch giving green lights on the main avenue is closed. By moving the shaft through some simple fraction of a revolution, such as 60 degrees, the switch is opened and another, perhaps that giving amber lights at the intersection, is closed. This device 4 is also directly supported on the panel. The panel 8 also carries a shelf 12 which supports a plug socket 13 and also supports the units 2.

A plate 14 is pivoted at 15 on the base 20 of each unit 2. This plate has one or more toes 16 that fit into positioning-slots in the shelf. A thumb screw 17 holds the plate in position on the shelf. The base 20 of each unit 2 carries a plug 18 so positioned that when the unit 2 is rocked about the pivot 15 with the plate 14 clamped in place by thumb screw 17, the plug will be aligned to enter socket 13 on the shelf.

It is evident that any one unit can be disconnected from the housing without disturbing the operation of the controller by the other units, simply by tilting the unit about pivot 15. If the desired adjustment cannot be made with the unit in this position, the thumb screw 17 is turned and the entire unit is lifted out of the housing.

Each unit 2 consists of a base 20 having a vertical wall 21 and a power unit generally indicated at 22. The construction of this unit is not shown in detail since it merely contains a suitable electric motor driver whose circuit passes through plug 18. This motor is essentially an electric clock synchronous motor and has the sole function of driving a shaft 23 carrying a pinion 24 at a uniform speed. This power unit 22 is mounted on a plate 25 which is clamped to the vertical wall 21 in such a vertical position that the pinion will mesh with a gear 26 carried by a shaft 27 passing through a bearing in the wall 21.

The plate 25 which carries the power unit has an ear 28 which supports a lever 30. One end of this lever is bent over as shown at 31 in Figure 7 and engages the underside of a flange 32 carried by the vertical wall 21 of the base 20. By turning the thumb screw 33 which bears against one end of the lever 30 the two parts are clamped together. If the two pieces are to be separated, the thumb screw is loosened and the power unit is lifted up, in Figure 6, which brings the end 31 of the lever out from under the flange 32 and the two parts can now be separated.

As will be seen from Figures 6 and 7, the lever engages the flange 32 about midway between the lateral ridges 29 and midway between the upper and the lower edges of the power unit 22. Thus the one clamp acting near the middle of the areas on the two sections of the unit to be clamped, will draw the parts together firmly.

The function of the power unit is to drive the pinion 24 at a uniform speed and this will cause the gear 26 and shaft 27 to turn at a speed inversely proportional to the diameters of the gear 26 and pinion 24. If the speed of

shaft 27 is to be slower, a larger gear is substituted for whatever gear 26 happens to be in place. That will of course change the distance between shafts 23 and 27 and the power unit, as seen in Figure 8, is now at a higher level than before.

One of the novel features of the invention is the means for assuring that when the two parts 25 and 21 are clamped together the pinion and gear will neither bind nor have excessive backlash. To accomplish this the vertical wall 21 is provided with a groove 35 in which rests a screw 36. The pitch of this screw in thousandths of an inch, may equal the increase in the distance between the centers of shafts 23 and 27 that is caused by each additional tooth in the particular gear that is substituted for another gear 27. If the gears to be used differ by a multiple of teeth, such as by increments of four teeth, the pitch of the screw may be four times the value just indicated. One end of the screw 36 fits into a seat 37 in a boss 38 on the wall 21. The other end of the screw 36 has a contracted collar 40 and a screw 41 is so placed that it both prevents the screw 36 moving axially because the screw 41 enters the contracted portion of screw 36, and if the screw 41 is drawn up, the head of screw 41 clamps screw 36 and prevents it from turning. Referring now to Figure 8, the plate 25 carries a boss 42, one face of which carries a thread of a pitch that matches that of screw 36. The screw 36 is so adjusted that when the teeth of the pinion and gear mesh without clearance, the teeth on boss 42 are just above the teeth on the screw. When the two sections of the unit are clamped by turning thumb screw 33 the teeth on boss 42 are forced down into the teeth on screw 36. In so doing, the pinion and gear are separated by whatever distance the teeth in boss 42 must move to seat in the teeth of the screw 36. Since the pitch of the screw 36 has been chosen so that it is the same as the distance the shafts are separated for one additional tooth in the gear, it is obvious that regardless of the number of teeth in the particular gear used at any given time the clearance thus provided will be the same.

If it is desired to change this clearance it is only necessary to loosen screw 41 and to turn screw 36 by applying a screw driver to the end of the screw. After turning the screw 36 through a very small angle it is again locked in place by tightening the lock screw 41.

It will be noted by referring to Figure 7 that the boss 42 is midway between lateral ridges 29, and by referring to Figure 8, that the boss is also about midway between the top and the bottom of the power unit. Thus, when the parts are clamped by tightening screw 33, the light die cast wall 21 and plate 25 are not endangered by being sprung because after the parts are in firm contact the stress of clamping is taken by the boss and transmitted through screw 36 to wall 21.

The shaft 27 carries a pinion 43 which measures with the internal gear 44 of a cylinder 45. This cylinder has an outer wall 46, a partition 47 and a central hub 48. The central hub is supported on needle bearings 50 on a stationary stud 51 fastened in vertical wall 21. This hub may be tapered as shown and a position indicating plate 52 may be force fitted thereon.

The outer wall of the cylinder carries equally spaced shallow grooves 53. Fingers of the type shown at 54 are carried in selected grooves and as the cylinder revolves at a fixed rate these fingers will engage the proper one of a number of switches supported by the wall 21 and having actuating arms shown at 55.

The backlash is greatly reduced by driving the cylinder in the manner indicated through a pinion 43 engaging the internal gear 44, rather than mounting the gear 26 on a central shaft carrying the cylinder as has been customary in similar devices.

The finger generally indicated at 54 must be readily movable from one slot to the other, but once placed in a given slot the finger must hold its position and neither

tilt nor slide out. It is desirable to maintain the groove 53 shallow so that the cylinder may be die cast. To secure fingers that will stand radial even though the grooves 53 are shallow, the finger 54 is U shaped as shown in Figure 11 and has two legs, 56, 57. Shallow grooves 58 are die cast into the upper edge of the inner surface 60 of the recess in the cylinder. The upper end of the shorter leg 57 has a portion 61 that slides into a groove 58 when the outer leg 56 slides into a groove 53. It will be understood that the inner groove 58 and the outer groove 53 are in the same radial plane. Thus the finger 54 will always be held in a radial plane on the cylinder even though the groove 53 is shallow. To assure that the leg 54 will always rest in the bottom of a groove, the inner leg 57 is made shorter and its end 62 is sprung away from leg 56 as the finger is pushed into place and end 62 rides down the tapered slope 60. To assure that the finger will not accidently slip out of place, the leg 56 carries a raised portion 63 that extends beyond the bottom of the cylinder as shown in Figure 10. To remove the finger it is necessary to spread the legs of the finger enough to allow the projection 63 to ride up on the surface of the cylinder. The fingers differ in the relative position of the raised portion 64 on leg 56 that contacts a switch arm 55.

When the particular switch controlled by one of arms 56 that is supplied with current is closed, the stepper shown in Figure 1 at 3 and in detail in Figure 4 is actuated. This stepper consists of a solenoid 65 whose core 66 coacts with the armature 67 riding loose on a cylindrical portion of shaft 68. When the armature 67 turns about shaft 68 the weight 70 strikes a stop 71 carried by an arm 72 that is also pivoted on shaft 68. This arm has several holes 73, and depending whether one or the other of these holes is aligned with the screw 74 carried by the stationary frame of the stepper, the weight 70 will be stopped after moving through a larger or smaller angle. When the weight is lifted the pawl 75 rides over the teeth of the ratchet 76. The ratchet is held against rotation in one direction by pawl 77 which is held against the ratchet by spring 78. However when the current through solenoid 65 ceases, the weight 70 will fall back to the position shown. In so doing, the pawl 75 will engage the ratchet and turn the shaft 68 through an angle equal to the distance the weight was lifted. That is determined by which of the holes 73 is at the moment aligned with screw 74.

Thus, by simply changing the position of arm 72 the angle through which the shaft 68 is turned at each actuation can be changed to another simple fraction of a complete revolution.

It will be obvious to those skilled in the art that the invention is not limited to the particular form here used by way of illustration.

We claim:

1. In an automatic controller, a timing unit consisting of a section carrying a pinion on a shaft normal to one face of the section, a second section carrying a gear on a shaft normal to one face of the second section, parallel aligning means carried by each of said sections permitting the two sections to be slid relative to each other until the pinion and gear are in mesh, a lever hinged to one section which extends parallel to said aligning means, a flange carried by the other section under which said lever extends, a screw extending parallel to said aligning means carried by one section, a mating thread carried by the other section which engages the thread of said screw when said sections are clamped together, means carried by said first section to swing said lever to draw the sections together and in so doing to slide the sections relative to each other sufficient for said threads to engage and thereby to provide operating clearance between the teeth of the pinion and the gear.

2. In an automatic controller, a timing unit consisting of a section carrying a pinion on a shaft normal to one face of the section, a second section carrying a gear on a

shaft normal to one face of the second section, parallel aligning means carried by each of said sections permitting the two sections to be slid relative to each other until the opinion and gear are in mesh, a lever hinged to one section which extends parallel to said aligning means, a flange carried by the other section under which said lever extends, a screw extending parallel to said aligning means carried by one section whose pitch is a multiple of the increase of the diameter of said gear resulting from the addition of one additional tooth, a mating thread carried by the other section which engages the thread of said screw when said sections are clamped together, means carried by said first section to swing said lever to draw the sections together and in so doing to slide the sections relative to each other sufficient for said threads to engage and thereby to provide operating clearance between the teeth of the pinion and the gear.

3. In an automatic controller, a timing unit consisting of a section carrying a pinion on a shaft normal to one face of the section, a second section carrying a gear on a shaft normal to one face of the second section, parallel aligning means carried by each of said sections permitting the two sections to be slid relative to each other until the pinion and gear are in mesh, a lever hinged to one section which extends parallel to said aligning means, a flange carried by the other section under which said lever extends, a screw extending parallel to said aligning means carried by one section whose pitch is a multiple of the increase of the diameter of said gear resulting from the addition of one additional tooth, means permitting said screw to be rotated without axial movement of the screw, a mating thread carried by the other section which engages the thread of said screw when said sections are clamped together, means carried by said first section to swing said lever to draw the sections together and in so doing to slide the sections relative to each other sufficient for said threads to engage and thereby to provide operating clearance between the teeth of the pinion and the gear.

4. An automatic device for closing various switches at predetermined times comprising, in combination, a plurality of switches, a plurality of fingers each of which is designed to actuate a particular one of said switches, a cylindrical drum having longitudinal slots into which said fingers may be fitted, a shaft carrying one of a number of gears of various diameters adapted to turn said drum, a housing supporting said switches and drum, a power unit containing a power means adapted to turn a pinion at a constant speed, aligning surfaces on said housing and said power unit permitting them to be moved manually relative to each other until the teeth of the pinion and gear mesh, a screw extending parallel to said aligning means carried by said housing, a mating thread carried by said power unit, clamping means which in the act of clamping the power unit to the housing will engage said thread and screw to slide the power unit relative to the housing to provide a definite clearance between the teeth of the pinion and gear.

5. In a device wherein fingers carried by a slowly revolving drum driven by a rapidly revolving pinion actuate switches with minimum backlash, in combination, a drum, a housing having a stud about which said drum may be turned, one cylindrical flange on said drum, grooves on both the outer and the inner surface of said flange, a finger engaging both one groove on the outer and one on the inner surface of said flange, a second flange on said drum having a circumferential gear, a shaft supported in said housing and having a pinion engaging said circumferential gear, a driving gear mounted on said shaft, a power unit that may be moved relative to said housing which includes a pinion that may be moved into firm contact with said driving gear, a screw extending parallel to said aligning means carried by said housing, a mating thread carried by said power unit, clamping means which in the act of clamping the power unit to the housing will engage said thread and screw to slide the power unit relative to the housing to provide a definite operating clearance between the teeth of the pinion and gear.

6. In an automatic controller, a timing unit consisting of two sections adapted to be used in various relative alignments, in combination, a section having two parallel edges, a hooked flange on said section located between said edges and extending parallel thereto, a second section adapted to be aligned on said parallel edges, a lever hinged on said second section that has one end which is adapted to extend under said flange and a second end accessible when the two sections are in contact, means for depressing the second end of said lever when the two sections are aligned in their desired relationship to cause the end extending under said flange to draw the two sections firmly against each other.

7. In an automatic controller of the type described in claim 4, a drum having a cylindrical flange, longitudinal grooves both on the outer surface and on a portion of the inner surface of said flange, and a finger having a U shape, the inner edges of the U fitting into grooves on the outer and the inner surface of said flange.

8. In an automatic controller of the type described in claim 4, a drum having a cylindrical flange, longitudinal grooves both on the outer surface and on a portion of the inner surface, and fingers made of spring metal and having a U shape, one leg resting in a groove on the inner surface of the flange, the other leg resting in a groove on the other surface of said cylinder, and a portion of said last named leg extending beyond the end of the drum and carrying a projection that prevents removal of the finger without springing the U shaped finger.

References Cited in the file of this patent

UNITED STATES PATENTS

807,888	Wallace	Dec. 19, 1905
1,022,742	Kellum	Apr. 9, 1912
1,380,953	Hagaman	June 7, 1921
1,713,685	Austin	May 21, 1929
1,733,872	Graseby	Oct. 29, 1929
2,028,786	Lamatsch	Jan. 28, 1936
2,459,107	Johnson	Jan. 11, 1949
2,498,807	Hagenbach	Feb. 28, 1950
2,542,853	Wills	Feb. 20, 1951
2,633,755	Bommelaer	Apr. 7, 1953
2,725,433	Reid et al.	Nov. 29, 1955