Feb. 6, 1951 D. G. TILTON 2,540,222

ADJUSTABLE PERIODIC CAM OPERATOR FOR SWITCHES

Filed May 17, 1946 2 Sheets-Sheet 1

FIG. 1

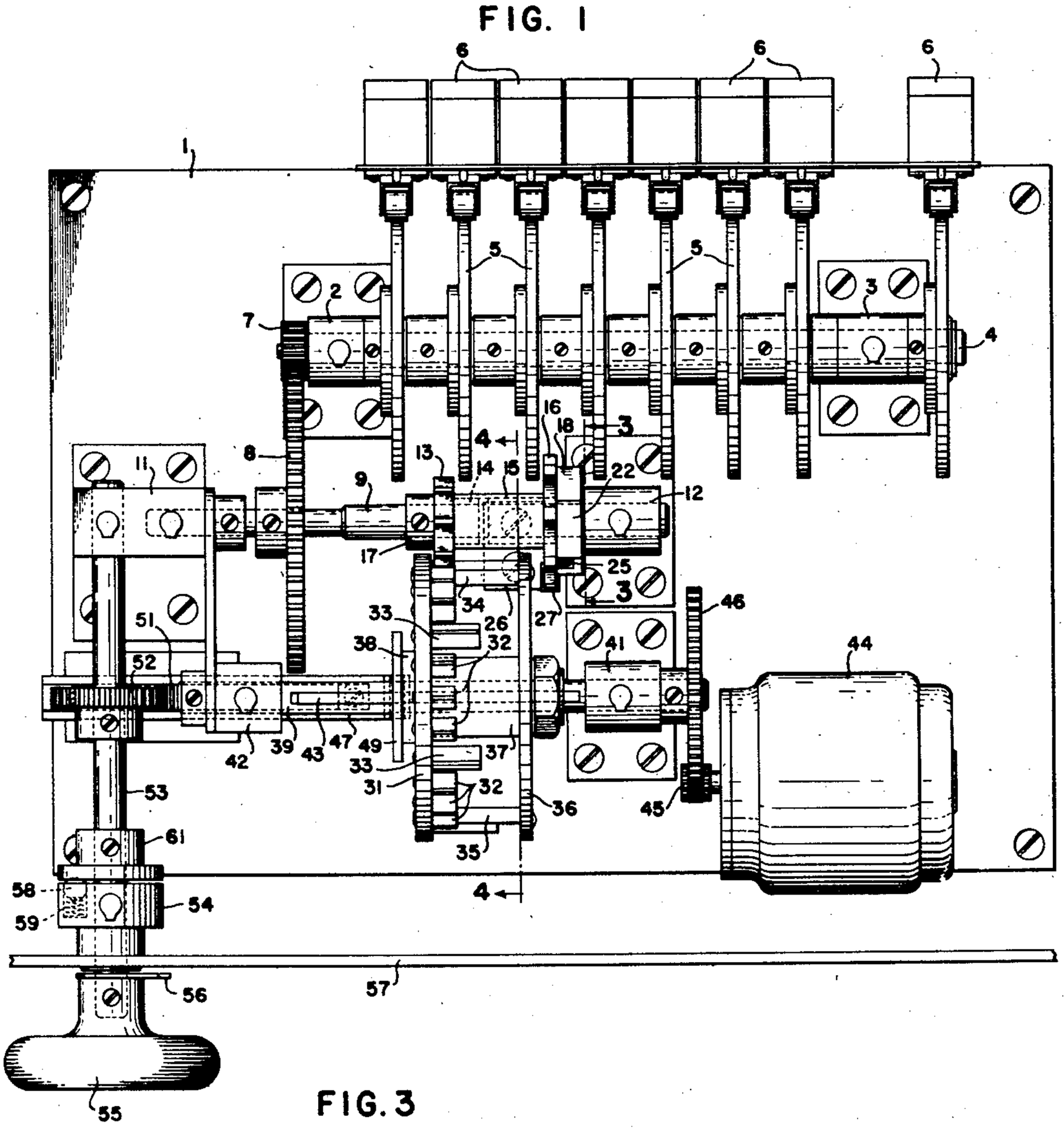

FIG. 3

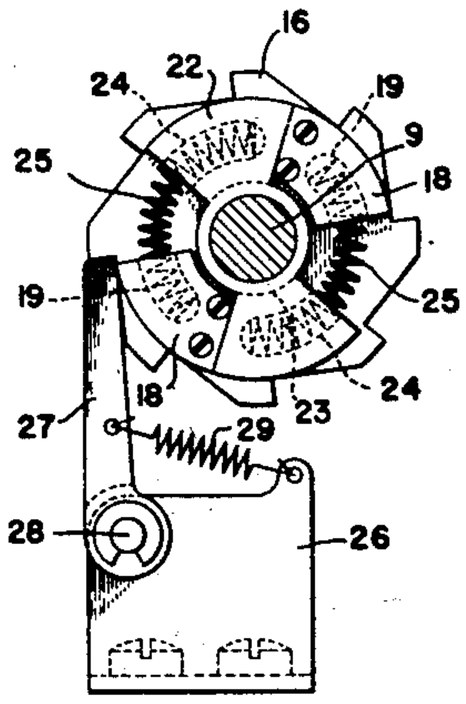

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FIG. 2

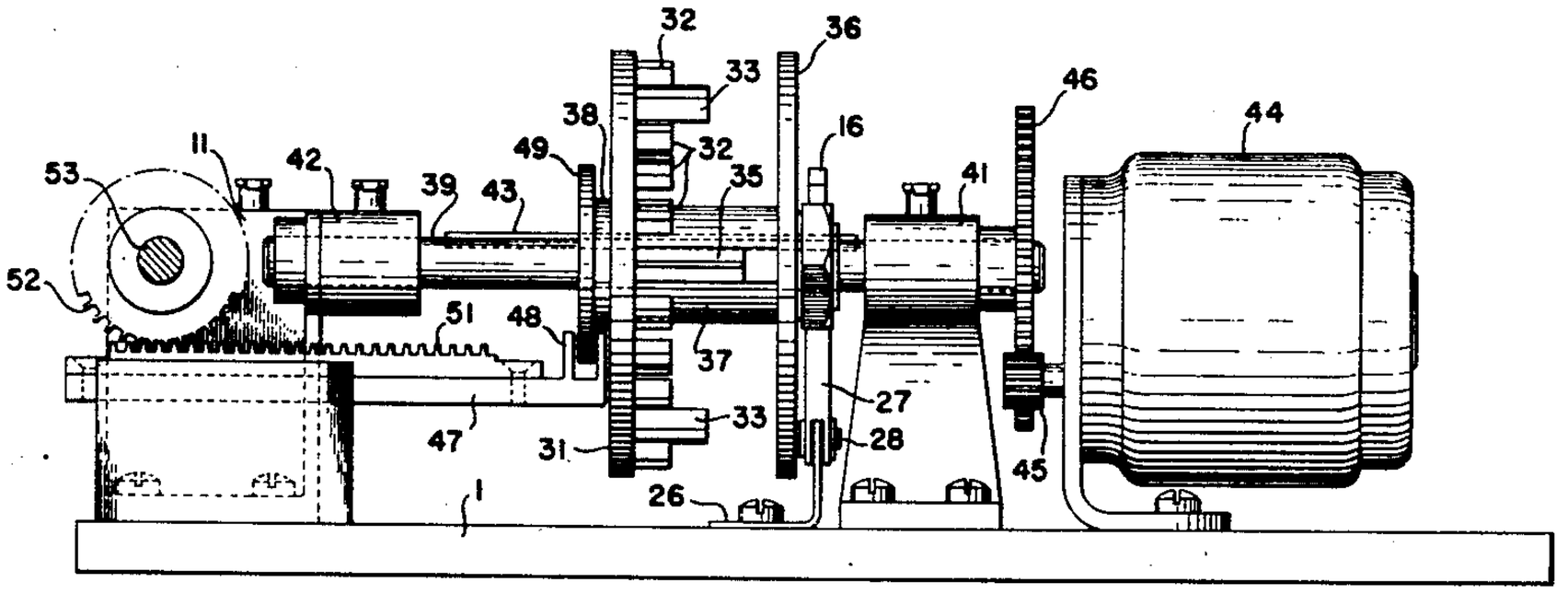
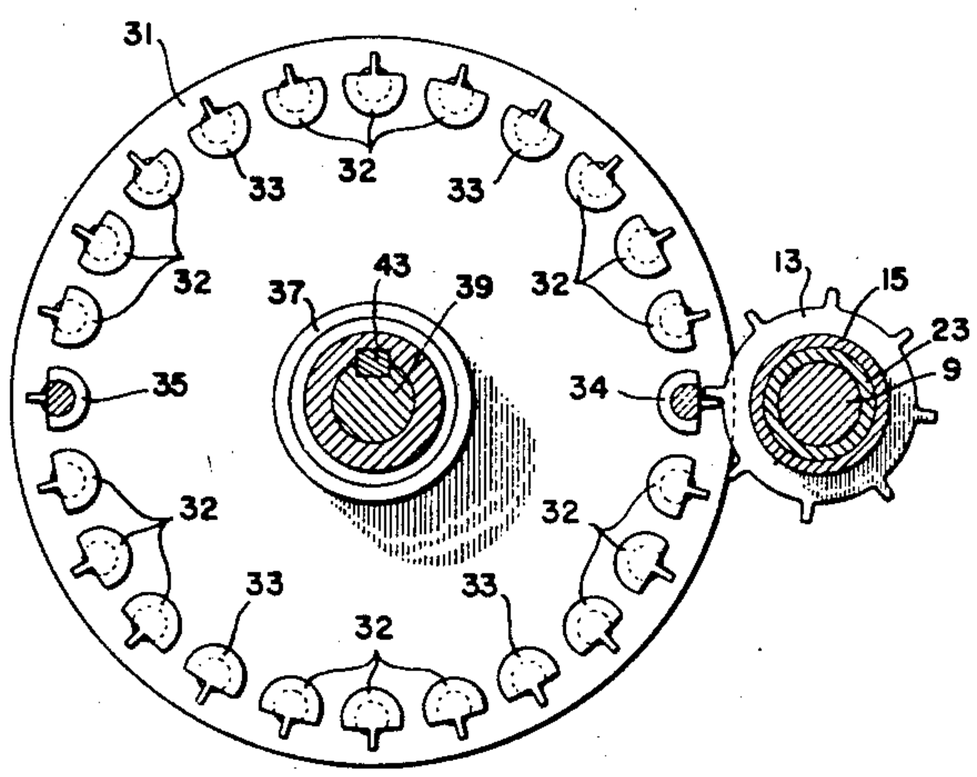


FIG. 4



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UNITED STATES PATENT OFFICE

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ADJUSTABLE PERIODIC CAM OPERATOR FOR SWITCHES

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8 Claims. (Cl. 74—1)

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The present invention relates to cyclically operated control apparatus, and more particularly to an apparatus whereby various mechanisms may be operated in a predetermined sequence, with provisions to vary the time occurring between each sequence.

In many industries it is desirable and necessary to perform a series of operations in a predetermined sequence with the same time interval between each operation. It is not always necessary, however, that the same time period elapse between the performance of each of the series of operations. The apparatus of the present invention is adapted to perform a series of operations as mentioned above, with various adjusted time periods taking place between each of the series of operations. This desideratum is accomplished by operating a plurality of control devices by a plurality of rotating cams. The cams are rotated at the same speed and for the same distance for each control sequence, but rotation is imparted to them intermittently at varying periods of time. The invention is described herein as operating a series of switches and it will be readily apparent that either electrical or pneumatic switches may be used, whichever is desired.

It is an object of the present invention to provide an apparatus by means of which a series of control operations may be performed. It is a further object of the invention to provide an apparatus by means of which the time occurring between a series of control operations may be varied at will. It is a further object of the invention to provide a novel cam rotating apparatus by means of which the cams may be rotated in a series of steps and in which the driving means for the cams will always be correctly positioned at the start of each operation.

The various features of novelty which characterize this invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects obtained with its use, reference should be had to the accompanying drawings and descriptive matter in which is illustrated and described a preferred embodiment of the invention.

In the drawings:

Figure 1 shows a top view of the mechanism,

Figure 2 shows a front view partly in section of Figure 1,

Figure 3 shows a view taken on line 3—3 of Figure 1, and

Figure 4 shows a view taken on line 4—4 of Figure 1.

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Referring first to Figures 1 and 2, it will be seen that there is provided a base plate 1 upon which the mechanism is mounted. Toward the rear of this plate there are two bearings 2 and 3 in which a shaft 4 is journaled for rotation. This shaft has mounted upon it a series of cams 5 which are used to open or close switches 6 as the came are rotated. These switches may be of any conventional type that can be operated between opened and closed positions by a cam, and it is intended that the cams operate the switches in a predetermined sequence.

Shaft 4 is rotated by a pinion 7 that is mounted on its end, which pinion is driven by a large gear 8 that is attached to the end of a shaft 9. The shaft is journaled for rotation in bearings 11 and 12. Shaft 9 is driven by a pinion 13 that is free on the shaft and which is connected to the shaft through a resilient connection. This pinion is shown as having eight teeth equally spaced around its periphery for a purpose to be described. The pinion is provided with a sleeve 14 extending to the right that is received by a sleeve 15 which projects to the left from a ratchet shaped member 16. The sleeve 14 and the sleeve 15 are fastened together so that the pinion positively rotates the ratchet. Ratchet 16 has two segment shaped members 18 attached to it that project to the right therefrom as best shown in Figure 3. Each of the segment shaped projections is provided with a recess 19. Cooperating with the projections 18 is a member 22 that is generally shaped like an hourglass. This member has a sleeve 23 extending from it to the left in Figure 1 that is loosely received by sleeve 15 and by means of which member 22 is attached to shaft 9. The hourglass member has formed in it two recesses 24. These recesses, along with the recesses 19 formed in projections 18 receive the ends of a pair of compression springs 25. When the parts are stationary the springs tend to rotate the parts to the relative position shown in Figure 3 in which each of the members 18 abut one of the sides of an end of the hourglass member 22. When the parts are rotating in a clockwise direction in Figure 3 it will be seen that pinion 13 and ratchet 16 will act on springs 25 to rotate member 22 and shaft 9 to which the latter is attached. There is provided a pawl 27 that engages the teeth of the ratchet to prevent retrograde movement thereof. This pawl is pivoted at 28 to a support 26 which is fastened to base plate 1. A spring 29 is provided to keep the pawl in engagement with the teeth of the ratchet. The teeth of the pinion are placed in a predetermined alignment with the teeth of the

ratchet so that each time pawl 27 engages a ratchet tooth one of the pinion teeth will be in a predetermined angular position.

Pinion 13 is driven by engagement between the teeth of that pinion and any one of the teeth formed on a series of pins that project to the right from a plate 31, as is best shown in Figures 1 and 2. Twenty-four pins are provided projecting from the face of this plate as is shown in Figure 4. As indicated in the drawings there are eighteen short pins 32 in groups of three. Between each of these groups is a medium length pin 33 or one of the long pins 34 or 35. Pin 35 has, as shown in Figure 1, the tooth cut away from its right hand end. The outer ends of pins 34 and 35 are received by a plate 36 so that the pins and the two plates taken together form what may be called a cage gear. The plates are mounted upon a sleeve 37 that has collar 38 formed on its left end. The entire unit is mounted on a shaft 39 for rotation therewith and for axial movement relative thereto. This shaft is journaled in bearings 41 and 42. In order to prevent the relative rotation between shaft 39 and the cage gear there is a key 43 that is placed in a keyway formed in sleeve 37. Shaft 39 is rotated by a motor 44 at a constant speed and in a counterclockwise direction in Figure 4. The drive means between the motor 44 and shaft 39 comprises a pinion 45 on the motor shaft and a gear 46 attached to shaft 39.

The cage gear can be adjusted axially of shaft 39 in order that different numbers of pins may engage pinion 13 as the cage gear is rotated. This is accomplished by a slider 47 that is mounted for axial movement in the support for bearing 42. As shown best in Figure 2, this slider is provided with a fork 48 that cooperates with a flange 49 formed on the left end of collar 38. The slider is moved by engagement between a rack 51 attached to its upper surface and a pinion 52 that is mounted upon a shaft 53. This shaft is journaled for rotation in bearings 11 and 54. Shaft 53 is provided with a knob 55 by means of which it can be rotated to move the cage gear to the right or left in Figures 1 and 2, and a pointer 56 that indicates the position of the cage gear. Pointer 56 can cooperate with a suitable scale if one is desired. The entire device may be and preferably is placed in a suitable casing a portion of which is indicated on the drawing at 57. Naturally the knob by means of which the cage gear is adjusted and the pointer are in front of the casing. Since it is necessary that the cage gear be positioned accurately in an axial direction with respect to pinion 13 there is provided in bearing 54 a small ball 58 that is forced by a spring 59 into one of four recesses made in a collar 61 that is attached to the shaft. This collar is so positioned on the shaft that as the shaft is rotated the cage gear will be accurately positioned in one of four positions when the ball snaps into one of the recesses.

With the parts in the position shown in Figure 1, the cage gear is so positioned that pinion 13 will be rotated by each of the twenty-four pins. With the cage gear moved one notch to the left only the two long and four medium length pins will be in a position to rotate the pinion. With the cage gear moved another notch to the left only the two long pins can engage the pinion, and with the next and the last position to the left the pinion will be engaged only by long pin 34, since pin 35 has its tooth removed for this position.

It is intended that the cage gear be rotated at a relatively slow rate of speed. It is also intended that gears 7 and 8 be so proportioned that cam shaft 4 be rotated through 180° for a rotation of shaft 9 equal to that imparted by one pin of the cage gear to pinion 13. Therefore as pinion 13 is rotated in a series of steps by the slowly rotating cage gear, cam shaft 4 will be given a series of rotations through 180°. If the cams are so shaped that a complete series of switch operations is obtained each time the cams rotate through 180°, it will be seen that the series of operations will be performed with a frequency depending upon how often one of the pins engages a pinion tooth. But in any event each series of operations will take place within the same period of time. The frequency of the series of operation is determined by the axial position of the cage gear since that determines how many pins will engage pinion 13 for each rotation of the cage gear. In effect it may be said that the cooperation between the cage gear and pinion 13 is substantially the same as that obtained by a Geneva gear mechanism.

As pinion 13 is rotated it rotates ratchet 16 and the segments 18 in a clockwise direction in Figures 3 and 4. The ratchet acts through springs 25 to move member 22 and rotate shaft 9 to which it is attached. Each time one of the pins engages one of the teeth on the pinion the ratchet will be rotated to a position so that pawl 27 will fall under one of the ratchet teeth. The parts will stay in this position until the pinion is again rotated by one of the pins on the cage gear.

The reason for the spring drive between the pinion and ratchet and shaft 9 is so that the teeth of the pinion will always be in position to be engaged by one of the pins even during the time that the cage gear is being shifted. If the pinion is not positioned properly so that one of its teeth is in a position to be engaged by one of the pins on the cage gear it is likely that a pinion and pin would meet in the wrong positions and one or the other of them would be broken. Most of the load in the device consists of the rotation of shaft 4 whereas there is practically no load on the pinion and ratchet. Therefore if the cage gear is shifted axially while the pinion is being rotated by one of the pins, shaft 4 will stop and springs 25 will move the ratchet and pinion in a counterclockwise direction in Figure 3 until one of the teeth of the ratchet engages pawl 27. The pinion will then be properly positioned to be engaged by the next pin of the cage gear as it comes into driving position. Thus it will be seen that no matter what position the parts may be in when the cage gear is shifted axially springs 25 will always return the pinion to the proper position so that it will be picked up by the next pin on the cage gear.

From the above description it will be seen that I have provided a simple device to perform a series of operations with variable time periods between each series. The device is simple in operation and easy to manufacture and is so designed that the various parts will be retained in their operative positions between periods of operation. It will, of course, be understood that while I have shown eight switches and eight cams a different number of each may be used if it is so desired.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of my invention now known to me, it will be

apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims, and that in some cases certain features of my invention may sometimes be used to advantage without a corresponding use of other features.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a switch operating device, a switch, a cam to operate said switch, means to rotate said cam comprising a shaft, a pinion, resilient drive means between said shaft and pinion, said means tending to reversely rotate said pinion when the latter is not being positively driven, means to limit reverse rotation of said pinion to one of a plurality of definite positions, and means to rotate said pinion.

2. In a switch operating device, a switch, a cam to operate said switch, means to rotate said cam including a shaft, a pinion, resilient drive means between said pinion and said shaft, said resilient drive means operating upon removal of power from said pinion to reversely rotate the same, means to limit the reverse rotation of said pinion to one or another of a plurality of predetermined positions dependent upon the position of the teeth on said pinion, and means to rotate said pinion in steps with any one of a plurality of time intervals between each step.

3. In a switch operating device, a switch, a cam to operate said switch, means to rotate said cam including a shaft, a pinion having a plurality of teeth, resilient drive means between said pinion and shaft, said drive means operating, when said pinion is not being positively rotated to reversely rotate said pinion, means to stop the reverse rotation of said pinion with one of its teeth in a predetermined position, and means to drive said pinion engageable with the teeth thereof when they are in said predetermined position.

4. In a switch operating device, a switch, a cam to operate said switch, means to rotate said cam including a pinion, a cage gear having a plurality of teeth of different lengths thereon, means to shift said cage gear axially of said pinion to bring various of the teeth thereon into position to mesh with the teeth of said pinion, and means to rotate said cage gear.

5. In a switch operating device, a switch, a cam to operate said switch, means to rotate said cam including a pinion having a series of equally spaced teeth, a device having a plurality of teeth to mesh with the teeth of said pinion, the teeth of said device all extending from one side thereof toward the other side, said teeth being of various lengths whereby different numbers of teeth on said device may be brought into position to engage the teeth of said pinion by shifting said device axially, means to shift said device axially and means to rotate said device.

6. In a switch operating device, a switch, a cam to operate said device, means to rotate said cam including a pinion having a plurality of spaced apart teeth on its periphery, a cage gear having a plurality of teeth projecting from one side thereof, various of said teeth projecting for different distances, the cage gear being so located that its teeth will mesh with those of the pinion, means to shift said cage gear axially with respect to said pinion so that various numbers of teeth thereon will mesh with the teeth of said pinion, and means to rotate said cage gear.

7. In a switch operating device, a switch, a cam to operate said switch, means to rotate said cam comprising a shaft, a pinion having a plurality of equally spaced teeth, a resilient connection between said shaft and pinion, said resilient connection serving to reversely rotate said pinion when the latter is not being positively driven, means to stop the reverse rotation of said pinion with one of the teeth thereof in a predetermined position, a cage gear having a plurality of teeth of different lengths, means to shift said cage gear axially relative to said pinion so that different numbers of the teeth on said cage gear as it rotates will engage the teeth of said pinion, the predetermined position of the latter being the position in which the two sets of teeth will engage as said cage gear rotates, and means to rotate said cage gear.

8. A control apparatus for intermittently operating at least one control device through a fixed cycle of operations, said cycle of operations being spaced at different selected periods of time comprising, a cam for operating said control device, a driven pinion connected to said cam so as to drive it, a cage gear having teeth of varying length arranged to engage with the teeth of said pinion, a spring-operated ratchet-and-pawl mechanism stressing said pinion so that one of its teeth is in a position to be engaged by one of the teeth of said cage gear, an operating motor connected to said cage gear so as to rotate it, a rack-and-pinion mechanism having engagement with said cage gear so as to cause axial movement of said cage gear relative to said pinion so as to select the length of the tooth of the cage gear adapted to engage a tooth of said pinion while permitting rotation of said cage gear, and a manually operable handle having driving engagement with said rack-and-pinion mechanism to provide for manual adjustment of said cage gear.

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