United States Patent [19]

Wooley

[11] **3,738,185**

[45] **June 12, 1973**

[54] **SEQUENTIAL TIMER**

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[73] Assignee: **The Scott & Fetzer Company**, Kokomo, Ind.

[22] Filed: **Apr. 26, 1971**

[21] Appl. No.: **137,138**

[52] **U.S. Cl.** **74/116**

[51] **Int. Cl.** **F16h 29/00**

[58] **Field of Search** 74/116, 117, 118, 74/119, 120, 121, 122, 142

[56] **References Cited**

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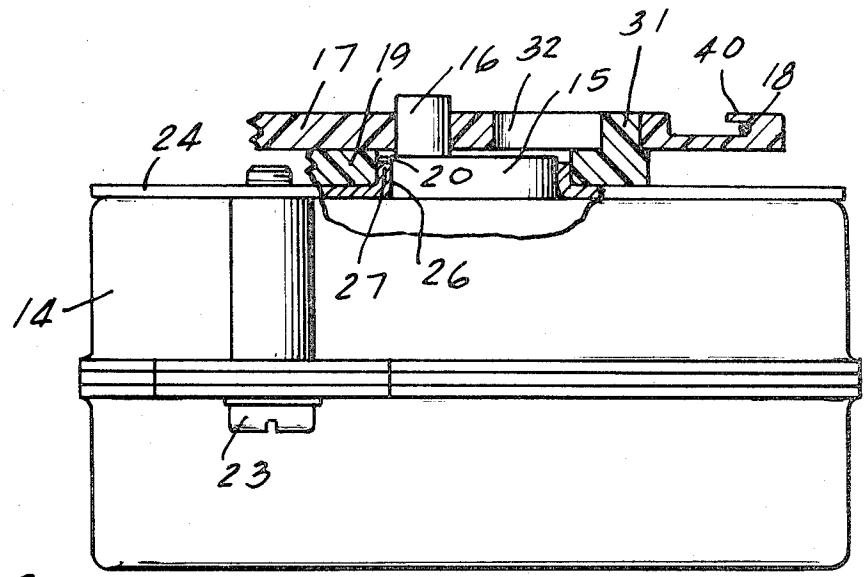
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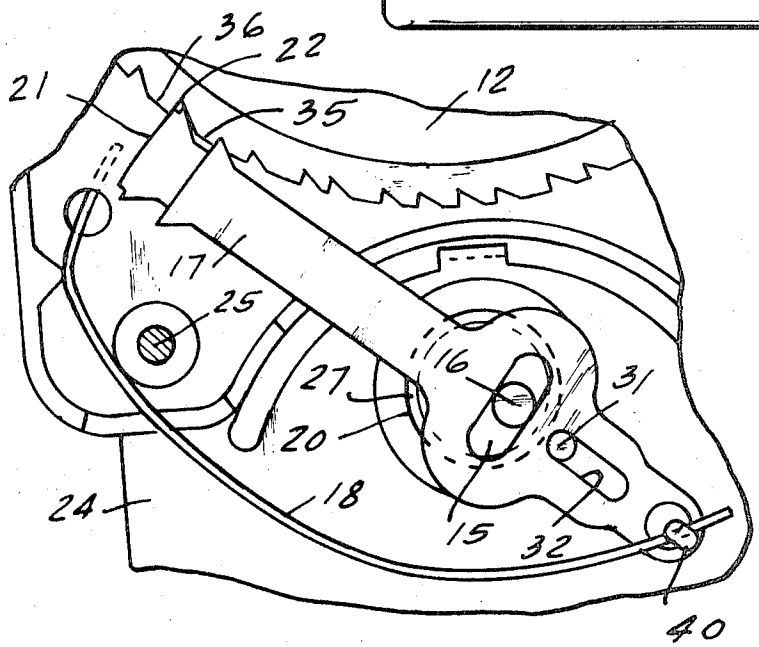
Primary Examiner—Charles J. Myhre
Assistant Examiner—Wesley S. Ratliff, Jr.
Attorney—Hill, Sherman, Meroni, Gross & Simpson

[57] **ABSTRACT**

A timer includes a disc-type of cam having circular tracks thereon for coaction with switches, all carried by a housing. A motor is mounted on the housing and has an eccentric that acts through a drive pawl on a series of peripheral teeth on the cam. A stop pawl is included which is pivotally mounted for movement about the rotational axis of the eccentric. The eccentric can rotate in either direction to produce incremental movements of the timing cam in one direction, and the pawls can be reversely mounted for use with an appropriate timing cam to produce timing cam movements in the opposite direction. The motor and eccentric can be removed without disturbing the assembled relation of the remainder of the device, such as for factory testing.

14 Claims, 5 Drawing Figures





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SHEET 1 OF 2

Fig. 1

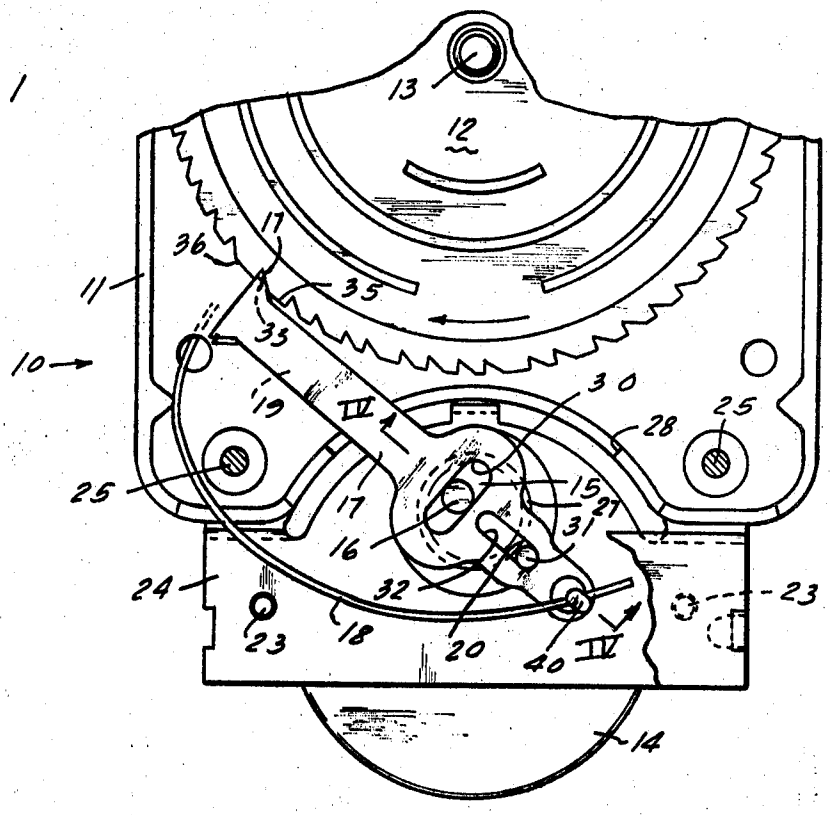


Fig. 2

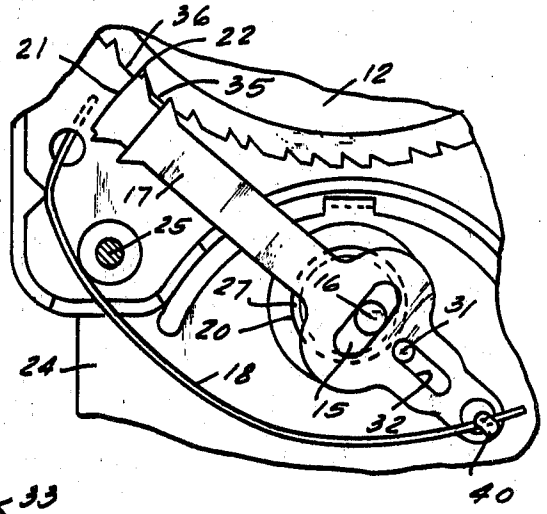
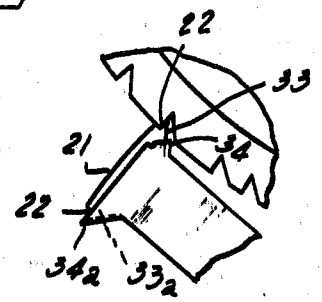


Fig. 3



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Fig-4

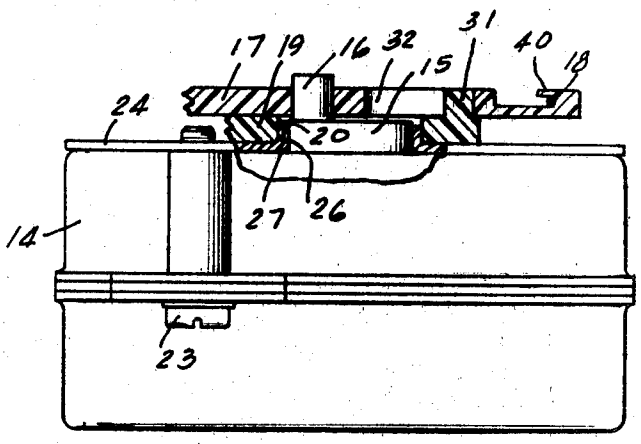
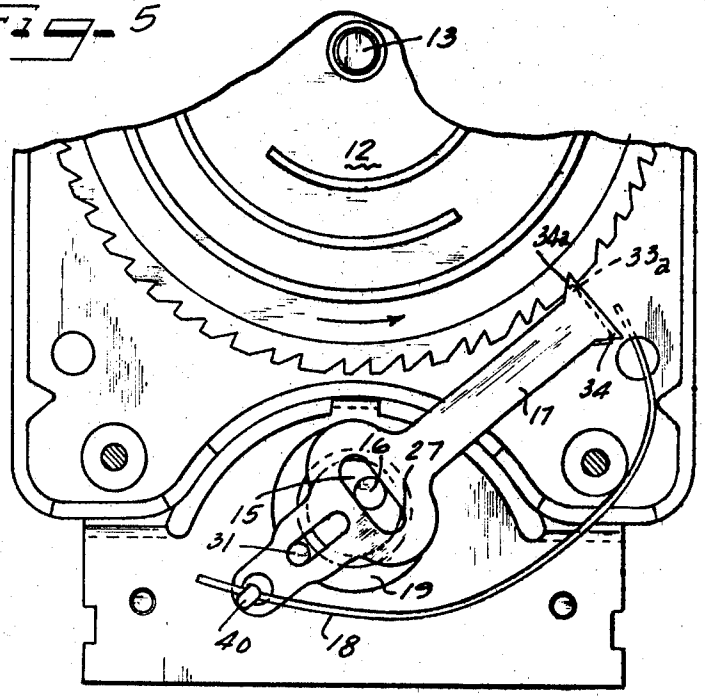


Fig-5



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SEQUENTIAL TIMER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention deals with a sequential timer wherein a main timing cam is moved incrementally at a creep rate.

2. Prior Art

Various types of timer constructions have been previously employed to control, by way of example, domestic automatic washing machines. By way of example, attention is invited to my U.S. Pat. No. 3,436,975. When a manufacturer produces timers for sale to manufacturers of washing machines, it is necessary that the timer manufacturer comply with various requirements of its customer. For instance, the customer will specify in which direction the cam is to rotate so that a manual control knob secured to a shaft that is connected to the timing cam will rotate in the correct direction. As a part of this requirement, the shaft must project in the right direction from the timer. Heretofore, it has also been necessary to procure or manufacture timer motors that rotate in the correct direction so as to be compatible with the timer construction. It is also necessary as a part of the manufacturing process to make appropriate running tests on each timer to insure correct operation. Where a timer cam has a program of substantial duration, the conducting of such tests is inherently time consuming.

SUMMARY OF THE INVENTION

In accordance with the present invention, there has been eliminated a need for specifying direction of motor rotation at its output, whereby motors having opposite directions of rotation at their output can be interchanged. Further, the same drive mechanism can be utilized irrespective of which direction the control shaft projects from a timer. Further, even before a motor is installed on the timer, the pawls can be reciprocated in a test fixture without significant time delay under otherwise actual operating conditions, whereby the test-time has been reduced. I have achieved the results described by utilizing a stop pawl that is pivoted about the rotational axis of the eccentric output member of the motor, the stop pawl having a pin and slot connection with a drive pawl, which in turn has a further pin and slot connection with the eccentric output member on the motor. A single spring biases both pawls by virtue of such connections against the timing cam teeth.

Accordingly, it is an object of the present invention to provide a sequential timer wherein the motor drives the main timing cam in a step-by-step manner, doing so at a creep rate for each step.

A further object of the present invention is to provide a sequential timer wherein the drive mechanism can be actuated under operating conditions even though the motor is temporarily absent, to facilitate testing and adjusting of the timer.

Another object of the present invention is to provide a sequential timer so constructed that it can be operated by a motor irrespective of which direction the motor may be rotating.

Yet another object of the present invention is to provide a sequential timer construction wherein the components can be utilized to drive a timing cam in one direction and can also be utilized to drive the timing cam in the opposite direction.

A still further object of the present invention is to provide a structure enabling the timer manufacturer to provide timers which have control shafts which may project in a first direction or selectably in an opposite direction.

Many other advantages, features and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description and the accompanying sheets of drawings in which a preferred structural embodiment incorporating the principles of the present invention is shown by way of illustrative example.

ON THE DRAWINGS:

FIG. 1 is a fragmentary side elevational view of a sequential time, with part of the housing removed and constructed in accordance with the principles of the present invention;

FIG. 2 is a fragmentary portion of the subject matter of FIG. 1 showing a changed relationship between components during operation;

FIG. 3 is an enlarged fragmentary detail of FIG. 1;

FIG. 4 is a fragmentary cross-sectional view taken along line IV—IV of FIG. 1; and

FIG. 5 is an elevational view of the subject matter of FIG. 1 with the parts assembled in an alternate manner.

AS SHOWN ON THE DRAWINGS:

The principles of this invention are particularly useful when embodied in a sequential timer of the creep-stepping type such as illustrated in FIG. 1, generally indicated by the numeral 10. The timer 10 includes a housing 11 within which is disposed a main timing cam 12, the cam 12 being corotatably secured to a manual control shaft 13 which in turn is rotatably supported by the housing 11. The cam 12 is provided with various tracks on one or both of its faces which jointly comprise a program for controlling a plurality of switches that form parts of electric circuits to be controlled by the timer 10. Thus, by the angular position of the timing cam, the various circuits are regulated.

A motor 14 is secured to the housing and has a rotatable output member 15 having a drive portion 16 eccentric to the rotational axis of the output member 15. A drive pawl 17 is connected to the eccentric drive portion 16 for being continuously reciprocated thereby. The drive pawl 17 is biased by a spring 18 to urge it into engagement with the timing cam 12. A stop pawl 19 has an aperture 20, around the fixed axis of which the stop pawl 19 is movably supported.

The timing cam 12 has circularly arranged teeth, some of which are of non-uniform angular size so that successive uniform reciprocations of the drive pawl effect incremental angular movements of the timing cam which are not of uniform angular size. The included angle for various teeth in this embodiment is 4°, 5°, 6°, and 8°. Normally each of the teeth has a size greater than half of the travel of the drive pawl 17. Owing to the fact that various tooth sizes can be employed, the stop pawl 19 has a tooth-abutting end face 21 which is notched as at 22 so as to provide two abutting end face portions which can engage with the drive or face portions of the various teeth. Normally one of the stop pawl teeth is received in the space between teeth of the timing cam as shown in FIG. 1, but if the timing cam

12 has not been rotated quite enough to enable the tooth of the stop pawl 19 to enter the space between cam teeth, it will partially enter as shown in FIG. 3.

The motor 14 is removably secured by a pair of screws 23, 23 to a motor mounting plate 24, which in turn is secured to the housing 11 by a pair of screws or rivets 25, 25 which holds two sections of the housing 11 together. One section of the housing 11 supports the various switches mentioned above for coaction with cam tracks disposed on one side of the cam 12. The other side of the timing cam 12 may have no cam tracks, and if that be the case, the housing 11 is closed by a mere cover, not shown. Where more circuits are needed, both sides of the timing cam 12 are provided with cam tracks, each track cooperating with switches supported by the adjacent housing section in a known manner.

The housing 11 has an aperture 28 through which the pawls 17, 19 project, the pawls 17, 19 both being pivoted outside of the housing 11.

As best seen in FIG. 4, the plate 24 has an aperture 26 defined by an annular flange 27, the outside of which is a bearing surface which is received in the aperture 20 of the stop pawl 19. The flange 27 is thus a bearing portion which encircles the rotatable output member 15 but which is received in the stop pawl aperture 20.

When the screws 23 are removed, the motor 14, along with the rotatable output member 15, may be slidably removed from the plate 24 and out of the aperture 26 respectively, the eccentric drive portion 16 similarly sliding out of the drive pawl 17. Nevertheless, the stop pawl 19 remains supported on the plate 24 with the bearing portion 27 of the plate 24 still projecting into and thus supporting the stop pawl 19. With the motor 14 removed, an instrument may be inserted to simulate the presence of the eccentric drive portion 16, and the same reciprocated to advance the timing cam 12 at will for proper adjusting and testing of switch functioning.

When the motor 14 has been installed as shown, the eccentric drive portion 16 projects into an aperture, namely an elongated slot 30 in the drive pawl 17, the length of the slot 30 extending transversely to the direction in which the drive pawl 17 is to reciprocate. To that extent, the slot 30 is thus substantially perpendicular to such direction.

There is a sliding connection provided between the pawls 17, 19, and in this embodiment such connection is a pin-and-slot connection wherein a pin 31 is provided on the stop pawl 19 and a slot 32 is provided in the drive pawl 17. The elongated slot 32 has its length extending substantially in the direction in which the drive pawl 17 is reciprocated.

In this embodiment, there is only one spring 18 and it acts on one pawl, in this embodiment the drive pawl 17, and through the sliding connection 31, 32 it also acts on the other pawl, namely the stop pawl 19, the spring 18 thus urging the ends or teeth of the pawls 17, 19 against the periphery or teeth of the timing cam 12.

Once during each stepping movement of the timing cam 12, the teeth or ends of both pawls 17, 19 are received in the same space between successive teeth on the timing cam 12. For example, as shown in FIG. 1, the notched tooth 33 of the stop pawl 19 and the tooth 34 of the drive pawl 17 are received in a space between a pair of adjacent teeth 35, 36. When the drive pawl 17 has been retracted as shown in FIG. 2 so as to enter the next space, the pawls are in adjacent spaces. However as the drive pawl 17 is reciprocated in a driving direction, near the end of such movement, the stop pawl 19 enters the same space between teeth as shown in FIG. 1.

As shown in FIG. 1, the timing cam 12 is moved in increments in a clockwise direction. If it were desired to rotate the timing cam 12 in the opposite direction, namely to contruct a timer that would so operate, the timing cam 12 can be inverted as shown in FIG. 5, the pawls 17, 19 having a second set of teeth 33*a*, 34*a*. Normally the control knob (not shown) that is secured to the shaft 13 in the corotatable manner would be expected to be rotated in a clockwise direction. If the shaft 13 projects toward the viewer with the parts assembled as shown in FIG. 1, the desired relationship will exist. However, if the shaft were to project away from the viewer, in order to achieve clockwise-appearing rotation, the timer would need to be mounted in a reverse position so that the shaft would now project toward the viewer, and this is the relationship that is illustrated by FIG. 5. Thus the shaft 13 projects toward the viewer in FIG. 1 and away from the viewer in FIG. 5, but when the structure of FIG. 5 is inverted so that the shaft projects toward the viewer, the rotational direction of the timing cam 12 will once more appear to be clockwise. The reason for such reverse positioning of the shaft is that the timer is not entirely symmetrical, especially at the motor, and therefore a reversal may be needed to accommodate assembly, installation of the like.

When the motor 14 is energized, the eccentric drive portion 16 is rotated in a circle, the rotational axis of which is at the center of the rotatable output 15. For purpose of explanation, if one considers the relationship of the parts as shown in FIG. 1 as being the start and as being the end of a stepping cycle, on energization of the motor 14, the eccentric portion 16 appears to move to the lower end of the slot 30, the amount of retraction of the drive pawl 17 being negligible. On reaching substantially the lower end of the slot 30, the eccentric portion 16 relatively rapidly retracts the drive pawl 17, remaining substantially at said lower end. During such retraction, the slot 32 is moved from the position illustrated in FIG. 1 with respect to the pin 31 to the position illustrated in FIG. 2, and then the eccentric portion 16 begins its travel from substantially at the lower end of the slot 30 to the upper end thereof. Upon reaching the upper end of the slot 30, the eccentric portion 16 acts on the upper edge of the slot 30 and drives the drive pawl 17 from the position illustrated in FIG. 2 to the illustrated position in FIG. 1, and thence recommences its travel along the length of the slot 30.

The description just given presumes that the direction of rotation of the eccentric portion 16 is counterclockwise. If a motor were utilized that had clockwise rotation, the eccentric portion 16 would be at the upper end of the slot 30 during retraction and at the lower end of the slot 30 during driving movement of the cam 12.

The spring 18 has one end bent to be received in an aperture in the housing 11, and its other end engages under a lug 40 on the drive pawl 17.

The fit between the eccentric portion 16 and the elongated slot 30 in the drive pawl 17 is free but is relatively close. The ends of the slot 30 are not engaged by

the eccentric portion 16 which nevertheless approaches quite closely thereto.

It is to be noted that the position of the pawls when assembled as shown in FIG. 1 is substantially at 90° to their position as shown in FIG. 5.

With the arrangement shown and described, the spring 18 urges whatever clearance there is to be taken up such that the parts are in engagement at all times as though the mechanism was then driving the cam 12. The spring 18 applies a force in a direction which is inclined at 45° to the direction in which the bias is desired. The slot 32 is slightly narrower than the slot 30, and its length is so constructed that it is equal to the distance which the drive pawl 17 is to be reciprocated during normal operation. Therefore, during testing, with the motor absent, the length of the slot 32 serves to simulate and to define the amount of reciprocation travel which the drive pawl 17 will have in actual operation, such simulation being for the purpose of test.

Although various minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such embodiments as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. A sequential timer for controlling a number of electrical circuits in accordance with a predetermined program, comprising in combination:

a. a housing;

b. a timing cam rotatably supported by said housing and having a series of circularly arranged teeth, said cam being adapted to control the circuits in response to its angular position;

c. a motor secured to said housing;

d. a rotatable output member driven by said motor and having a drive portion eccentric to the rotational axis of said output member and disposed in radially spaced relation to said teeth;

e. a single drive pawl having an aperture receiving said eccentric drive portion for being reciprocated thereby into direct driving engagement with a succession of said teeth for incrementally rotating said timing cam in a step-by-step manner in one direction; and

f. a stop pawl supported for pivotal movement about the fixed rotational axis of said output member for successively engaging said teeth to preclude rotation of said timing cam in an opposite direction.

2. A sequential timer according to claim 1, including a bearing portion on said housing encircling said output member, and received in an aperture in said stop pawl.

3. A sequential timer according to claim 2, including a plate to which said motor is secured and by which said motor is secured to said housing, said bearing portion being on said plate.

4. A sequential timer according to claim 1, including a sliding connection between said pawls, and a spring acting between said housing and one of said pawls and urging it against said timing cam, and through said sliding connection urging the other of said pawls against said timing cam.

5. A sequential timer according to claim 4, said sliding connection comprising a pin and slot disposed respectively in said pawls.

6. A sequential timer according to claim 5, said pin being on said stop pawl, and said slot being in said drive pawl and extending lengthwise substantially in the direction of its reciprocation.

7. A sequential timer according to claim 1, said drive pawl aperture being a slot extending lengthwise substantially perpendicular to the direction of the reciprocation of said drive pawl.

8. A sequential timer according to claim 1, said pawls each having a pair of oppositely facing teeth, one tooth of each pawl being engageable with the teeth of said timing cam to provide clockwise movements thereof, said pawls being selectively assemblable with the other tooth of each pawl engageable with the teeth of said timing cam to provide counterclockwise movements thereof.

9. A sequential timer according to claim 1, said motor and said output member being detachable as a unit from said housing without disturbing the assembled relation of said timing cam and said pawls with respect to said housing.

10. A sequential timer according to claim 1, the pivotal movement of said stop pawl being about a point external to said housing, said stop pawl extending with said drive pawl through an aperture in said housing to engage the teeth of said timing cam within said housing.

11. A sequential timer according to claim 1, both of said pawls being disposed in the same space between a pair of teeth on said timing cam once during each step of timing cam movement.

12. A sequential timer according to claim 1, including a single spring continually biasing both of said pawls against the teeth of said timing cam.

13. A sequential timer according to claim 8, in which said oppositely facing teeth of said stop pawl are notched so as to define two end face portions spaced from each other on each pawl tooth.

14. A sequential timer according to claim 1, said drive pawl aperture being an elongated slot extending transversely to the direction of reciprocation, and said pawls having a pin and slot connection there-between in which the slot extends in said direction of reciprocation.

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