May 18, 1954 W. A. BLACK ET AL 2,678,570

MECHANISM FOR OPERATING ELECTRIC SWITCHES

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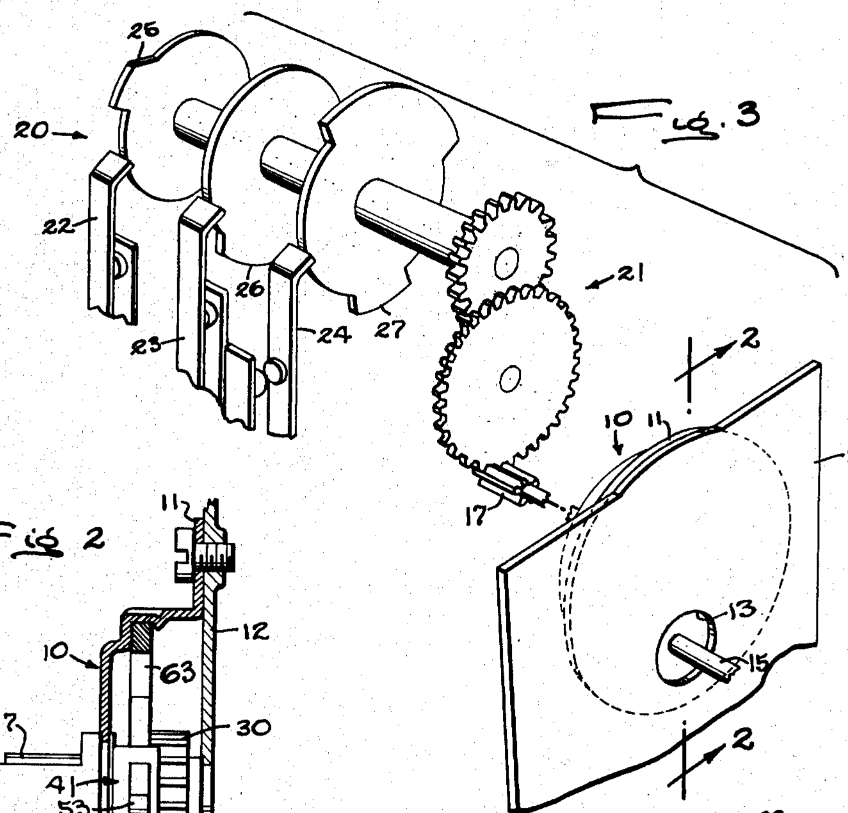

Fig. 3

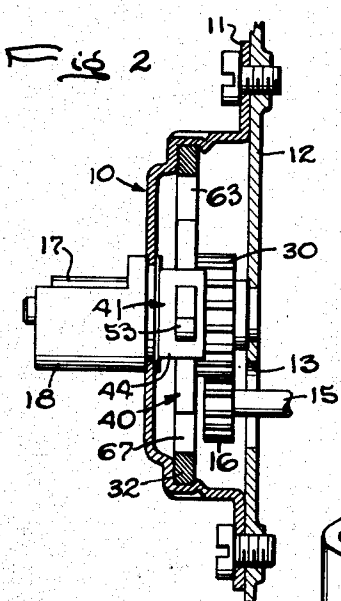

Fig. 2

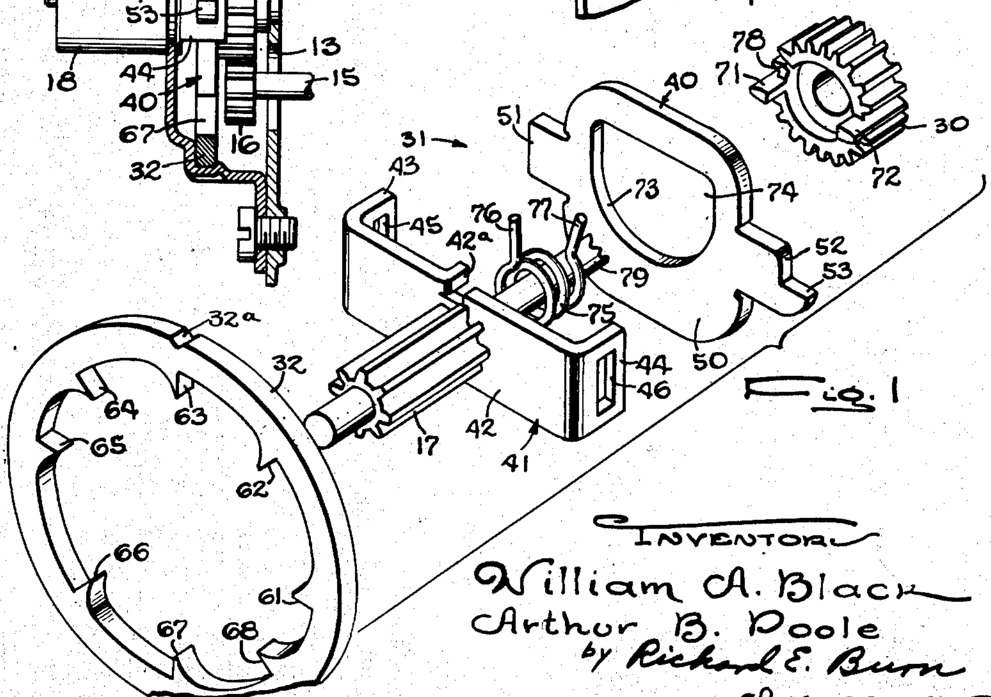

Fig. 1

INVENTORS
William A. Black
Arthur B. Poole
by Richard E. Burn
ATTORNEY

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Fig. 4

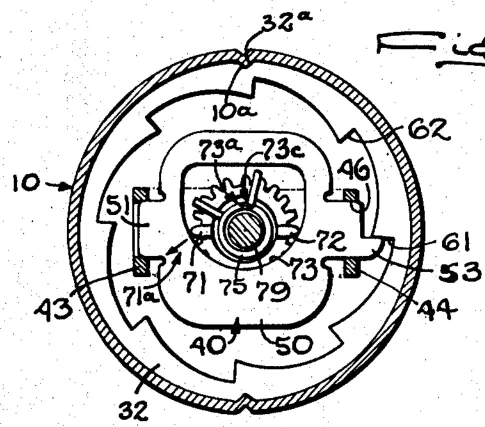


Fig. 5

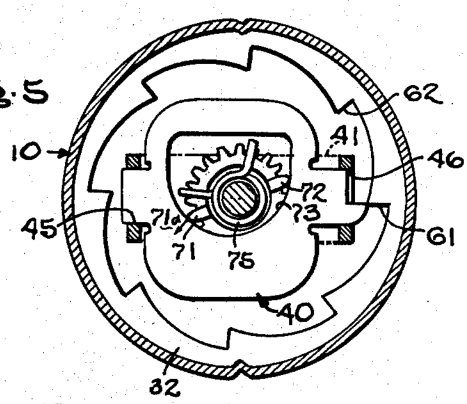
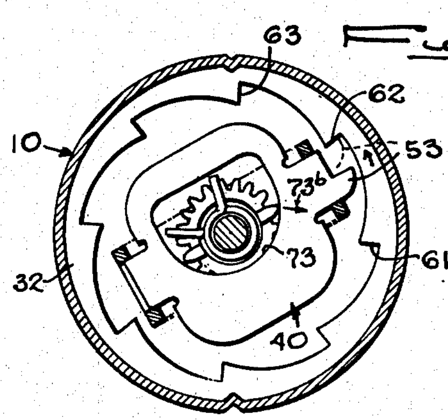


Fig. 6



INVENTORS
William A. Black
Arthur B. Poole
by Richard E. Burns
ATTORNEY

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MECHANISM FOR OPERATING ELECTRIC SWITCHES

William A. Black, Montclair, N. J., and Arthur B. Poole, Harwinton, Conn., assignors to Haydon Manufacturing Company, Inc., Torrington, Conn., a corporation of Connecticut

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1 Claim. (Cl. 74—569)

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The present invention relates to clock actuated switches and more particularly to a mechanism for obtaining snap action from a continuously running clock train.

It is an object of the present invention to provide a snap action mechanism for driving multi-contact electric switches which is more simple and compact in construction, more positive in operation, and lower in cost than preceding mechanisms of the same general type.

It is a more detailed object to provide an improved step-by-step snap action mechanism in which friction is reduced to a minimum, which is proof against faulty operation as a result of severe shock and vibration, and in which synchronism between clock and switch is absolutely assured.

Other objects and advantages of the invention will become apparent as the discussion proceeds and upon reference to the drawings, in which,

Figure 1 is an exploded view of the mechanism embodying the present invention.

Fig. 2 is a vertical section looking edgewise at the mechanism with the parts assembled.

Fig. 3 shows a typical multi-contact cam switch arrangement suitable for use with the mechanism of Figures 1 and 2.

Fig. 4 is a stop motion view at the beginning of a cycle of operation.

Fig. 5 is a stop motion view at the releasing point of the cycle.

Fig. 6 shows the mechanism immediately upon release.

While the invention is susceptible of various modifications and alternative constructions and uses, there is shown in the drawings only one embodiment of the invention. It is to be understood, however, that it is not intended to limit the invention by such disclosure and the aim is to cover all modifications and alternative constructions and uses falling within the spirit and scope of the invention as expressed in the appended claim.

Referring to the drawings, the snap mechanism is included in a housing **10**, which is generally cup-shaped and which has a circular mounting flange **11**. The mounting flange is fastened to a mounting plate **12** having an aperture **13**. Extending through the aperture is an input shaft **15** which carries at its end an input or drive pinion **16**. The shaft is connected to the driving train of a synchronous clock motor (not shown).

At the other side of the housing **10** is an output pinion **17** which is partially enclosed in a

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shield **18**. As will be covered in greater detail as the discussion proceeds, the output pinion **17** is advanced intermittently and with a snap-action upon continuous driving of the input pinion. Such intermittent action is employed to operate a switch mechanism generally indicated at **20** (Fig. 3) which is connected to the pinion **17** by means of a gear train **21**. The switch **20** may be of a conventional type in which the switch blades **22**—**24** are raised and lowered by cams **25**—**27**. Since the cam drive takes place rapidly and with a snap action the switch contacts will be operated correspondingly quickly, thereby reducing arcing at the contacts and greatly increasing contact life as well as improving the accuracy of the timing. The present mechanism is especially applicable to switches employed in automatic washers for controlling the washing, rinsing and centrifugal drying cycles.

Referring now to the snap-action mechanism in greater detail, it will be seen that it includes a cam gear **30**, a ratchet mechanism **31** and a circular ratch **32**. The ratchet mechanism is so constructed that rotation of the cam gear causes unlocking of the ratchet with the result that the ratchet mechanism is advanced periodically from one ratchet tooth to the next upon passage of time.

The ratchet mechanism **31** includes a pawl member **40** which is slidably mounted in a pawl carrier **41**. For this purpose, the pawl carrier has a transversely extending body **42** and two inwardly turned ends **43**, **44**, making the carrier of generally U-shape. In the ends **43**, **44**, are guides in the form of rectangular openings **45**, **46**, which are alined with one another. The pawl member **40** has a body indicated at **50** having outwardly extending arms **51**, **52**, which are dimensioned to be slidably received in the openings **45**, **46**, of the carrier. The body of the pawl member is of lesser width than the carrier so that the pawl member is free to slide back and forth in the carrier. The path of movement is preferably diametrical with respect to the axis of rotation of the carrier.

At the outer end of the arm **52** is a radially extending tooth or pawl **53**. The latter is of such size as to readily engage the ratchet teeth **61**—**68** which are internally arranged on the ratch **32**.

In carrying out the invention novel means are provided for withdrawing the pawl **53** from a given tooth upon rotation of the cam gear **30** and for simultaneously storing up energy so that the pawl may be snapped over to the next tooth in the series. For this purpose the cam gear **30** includes cam members **71**, **72**. These cam members are spaced apart on the gear 30 and are preferably formed as an axial extension of two diametrically arranged gear teeth. For the purpose of cooperating with the cam members 71, 72 the pawl member 40 includes a curved internal cam surface 73. Such surface is so formed as to produce retraction of pawl 53 when the gear 30 is rotated, as will be covered in detail.

The cam surface 73 is preferably formed as one wall of a D-shaped opening indicated at 74. For the purpose of storing energy for the snap action a spring 75 is interposed between the cam gear 30 and the pawl carrier 41. This spring 75 includes radially extending ends 76, 77, the end 77 being received in a slot 78 in the cam gear while the end 76 engages an inwardly turned hook or abutment 42_a on the carrier 42. Both the cam gear 30 and the spring 75 are loosely slipped over a shaft 79, which shaft is rigidly fastened to the pawl carrier 41.

When the device is assembled as shown in Fig. 2, it will be seen that all of the parts are compactly nested together so that the total thickness of the mechanism may be made little more than the thickness of a pocket watch. The cam members 71, 72 are received in the opening 74 in the pawl member and the pawl member itself is mounted within the pawl carrier 41, with the pawl 53 lying in the plane of the ratchet teeth 61—68.

The operation of the assembled device will be apparent upon reference to Figures 4, 5 and 6. Fig. 4 is a stop motion view showing the initial condition of the ratchet mechanism. The pawl 53 is engaged with the ratchet tooth 61 and the cam members 71, 72 are symmetrically arranged with respect to the cam surface 73. The cam surface 73 is of shallow arcuate shape and is dimensioned to accommodate the cam members 71, 72 when such cam members are arranged crosswise therein and with the pawl member extended for engagement with a ratchet tooth. The cam surface 73 is formed by two intersecting arcs with centers of curvature at 73*a* and 73*c*. As shown in Fig. 4, these centers 73*a* and 73*c* lie above the axis of rotation of the cam members 71, 72, so that the cam members rotate about an axis that is eccentric with respect to the curvature of said cam surface.

The effect of this arrangement will be made clear upon reference to Fig. 5, which shows the position of the members after a certain amount of counterclockwise movement of the cam gear 30. It will be seen in this figure that the cam member 71 has moved downwardly against the cam surface 73 with a wiping action. During such action the radius of the cam surface 73 relative to the center of the shaft 79 becomes less and less, and continued movement of the cam gear results in the application of force as indicated at 73*a* and the camming of the pawl member 40 to the left as viewed in Fig. 5.

During the time that such movement is taking place the cam member 72 moves upwardly along the right-hand portion of the cam surface 73, thereby permitting the pawl member 40 to move slowly to the left. However, it will be noted that the cam member 72 remains in contact with the cam surface 73 as it moves upwardly, thereby preventing the pawl member from being jarred into its fully disengaged position (to the left) as a result of shock and vibration. In brief, the pawl member is locked with respect to the tooth 61 and the only thing which can unlock it is full retraction by the cam gear. As a result, premature operation of the switch is positively prevented even in washers having a large amount of vibration during the centrifugal drying cycle.

Since only a small area of the cam surface is engaged, the frictional force which must be overcome during camming is small. Further, all sliding movement of the pawl member at the pawl itself and at the guides 45, 46, takes place along smooth surfaces and at right angles to the applied forces. It will therefore be apparent that practically all of the energy supplied to the mechanism by the clock may be usefully employed to operate the switch and a minimum of energy is wasted in overcoming friction.

During counterclockwise rotation of the cam gear 30, the spring 75, one end of which is engaged with the gear 30, is tensioned, thereby applying a progressively increasing torque to the pawl carrier 41. This torque is in such direction as to urge the pawl carrier in a clockwise or advancing direction. The carrier is, however, locked in place until the cam gear turns through a predetermined angle. This condition is shown in Fig. 5 where the pawl 53 is almost fully retracted, enabling the spring to snap the entire mechanism over to the next tooth 62.

The snap action is illustrated in Fig. 6, where it will be seen that the pawl 53 is moving in the direction of the arrow into the dotted position in which the pawl is fully seated against the tooth 62. During the snap action practically all of the energy previously stored in the spring 76 is utilized to advance the gear train 21 associated with the switch 20. To insure accurate timing, the switch cams 25—27 are preferably so arranged that drop-off of the contacts takes place at the mid-point of the advancing step.

During the instant of snap-over the cam members 71, 72 remain substantially fixed in position and the pawl member rotates relative to these two cam members. During such rotation the right-hand portion of the cam surface 73 wipes against the cam member 72. This applies a pressure against the cam surface 73, as indicated by the arrow 73_b, which, as will be seen in Fig. 6, has a large component tending to force the cam member to the right (outwardly) for engagement with the next tooth 62. The wiping action of the cam surface against the cam member 72 insures that the pawl will be moved outwardly in ample time to engage the next tooth. Thus, there is no possibility of "missing a tooth" and synchronism of the clock switch is accurately maintained.

Upon further rotation of the cam gear 30 the entire cycle of operations outlined above is repeated and the pawl 53 is caused to clear the tooth 62, coming to rest seated against the tooth 63. The cycle is repeated for each of the successive teeth.

The pawl member 40 and the ratch 32 are preferably constructed of metal which may be hardened so that there is substantially no wear even after many thousands of cycles of operation. Each of these pieces may be made of a simple and inexpensive stamping. The pawl carrier 41 may also be a metal stamping, the blank being punched prior to inturning the ends thereof. The cam gear 30 may be simply constructed by employing an extra wide gear and then simply milling off the teeth on two opposite sides to leave only two teeth 71, 72, which serve as the cam members.

The ratch 32 is pressed into the housing 10, being received on a suitable internal rim or shoulder. If desired, the circular ratch may be locked in place by forming a groove 32a in the periphery thereof, which registers with raised internal ridge 10a on the housing 10.

From the foregoing it will be seen that the entire mechanism requires no parts which are special or difficult to fabricate. It may be constructed of simple stampings and with a minimum of milling or cutting operations. Operation is positive, the intermittent advancing torque being limited only by the strength of the spring 75 which in turn is limited by the torque available from the clock train. Such torque need not be great, however, since the energy which is stored up in the spring over a long period is released suddenly and with great force during a very short period. Further, since the moving parts are light in weight and symmetrically arranged and since the "angular step" is small (only 45°), operation is much quieter than in snap mechanism previously employed. In spite of its small size, it has been found that the mechanism is capable of driving large and relatively heavy switch mechanisms.

What is claimed is:

A device for converting rotary motion to reciprocating motion including a housing, a shaft supported in said housing, a driven cam gear rotatably mounted on said shaft, said cam gear

having a pair of cam abutments in the form of axially extended gear teeth on opposite sides of said cam gear, a member supported in said housing for reciprocable movement, a curved internal cam surface on said member engaged by one of said cam abutments during rotation of said cam gear to move said member linearly, and a second curved internal cam surface on said member engaged by the other of said cam abutments to lock said member against premature movement due to shock or vibration.

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