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SWITCHING MECHANISM WITH ENERGY STORAGE MEANS

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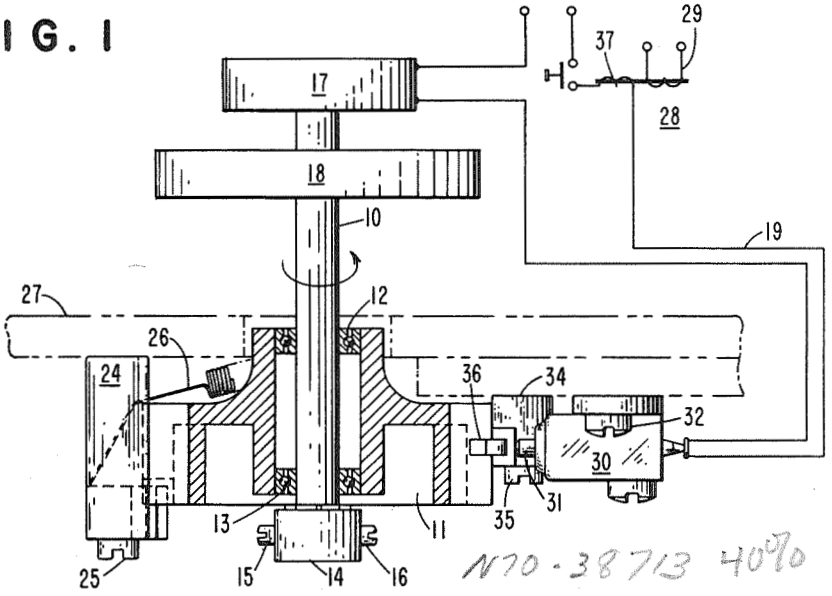
FIG. 1



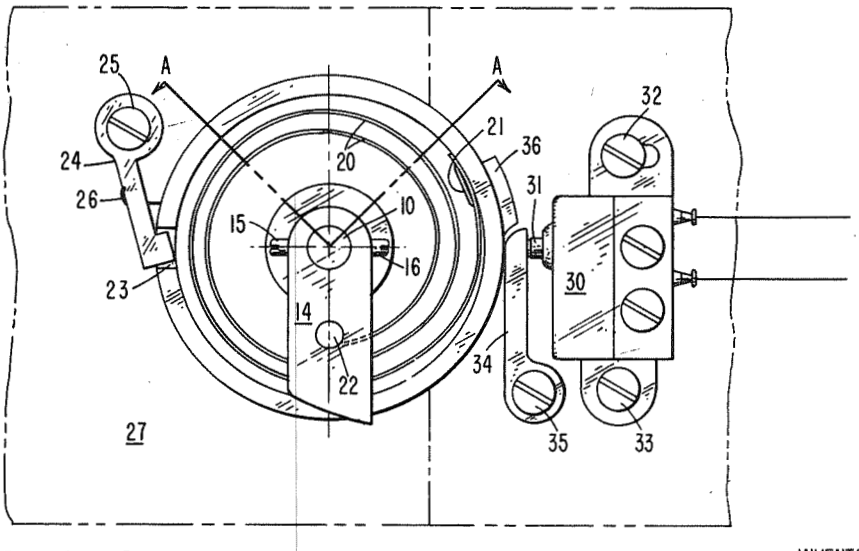


FIG. 2

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SWITCHING MECHANISM WITH ENERGY STORAGE MEANS

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of royalties thereon or therefor.

This invention relates to an improved switch actuation mechanism and more particularly to a driven switch actuation mechanism including a mechanical reset feature capable of completing its cycle of operation after the input drive has been deactivated.

Occasions will often arise when it is desirable to utilize the final mechanical motion of a given operation to effectuate its own termination. For example, when using a magnetic drum as an information storage device it may be desired to cause the drum to rotate past a pickup head for one revolution and then to terminate its own motion. A protrusion or similar means may be located on, or connected to, the body of the drum so that at the completion of the desired rotation the protrusion will actuate suitable switching means to terminate the operation in accordance with the actual position of the drum. This feature of self-termination of operation is frequently utilized with many diverse types of equipment wherein it is desirable that a second operation, or a repetition of the first cycle, be caused to occur at some later time.

For such purposes it is common practice to utilize separate control circuits to effectuate initiation and termination of the operational sequence. In space applications, for example, a satellite vehicle may carry scientific equipment that begins to operate when a signal pulse is received by a satellite carried radio receiver. This pulse may be sufficient to actuate a switch, latching relay or similar device which will then maintain the circuit in an operative condition after the pulse is terminated. A completely independent circuit may be utilized to effectuate circuit cutoff or termination when a cutoff signal is received or on the occurrence of a predetermined event. When separate start and stop circuits are used, the stop circuit is often in the form of a switch or similar device which momentarily opens a power line. In such cases it is usually required that the switching means, which opens the circuit, be returned to a closed position prior to the initiation of a second operational cycle.

A careful inspection of the problem will make evident that when rotary mechanical means are utilized to actuate a motion termination or cutoff switch an additional operation may be required to reactivate the switch prior to a second cycle. For example, a rotating cam which actuates a push button type switch that terminates the cam rotation may coast beyond the switch mechanism, if sufficient inertia is present, thereby allowing the switch to return to its normal position. On the other hand, the cam may come to rest in a position which will maintain the motion termination switch in the depressed position when the power circuit is de-energized. If such an event is allowed to occur it is usually necessary that the motion termination switch be returned to its operative position prior to initiation of a second cycle.

Thus, it will be realized that in certain rotating devices, utilizing a mechanically actuated motion termination switch, which rotates with insufficient momentum to clear the switch mechanism and allow it to reset, additional means will be required to complete this operation.

Switching devices of the type described are often utilized on tape recorder playbacks which are incorporated in satellite vehicles. It will be appreciated that, considering the constraints imposed by the environment of operation, simple and efficient means must be provided to insure that the playback operation will not be terminated in such a manner that recycling will be prevented. On the other hand, it is extremely desirable that simple and reliable means be incorporated as a part of the rotating device for terminating such rotation at a desired position in order to conserve the space and weight that otherwise would of necessity be allocated to ancillary equipment adapted for this purpose.

The present invention includes as one of its features a rotatable mechanical energy storage mechanism which stores energy in a coil spring as a result of the rotation of the driven object and which is triggered by that object reaching a desired termination position. The mechanism of the invention will store sufficient energy to allow a cutoff switch to be actuated thereby and then permitted to return to its normal operating position.

Coil spring operated switch actuation mechanisms are found in the prior art but generally have been directed toward timing circuits which prevent the application of a voltage to a vacuum tube or the like for a predetermined period of time following an interruption in the filament voltage in order that a sufficient period is allowed for reheating. Such devices, which are actuated by the position of a driven shaft, result in rotation of a disc in a direction opposite to that of shaft rotation so that, in effect, a rotating switch contact mounted on such a disc has its direction of rotation reversed for a sufficient period of time to allow filament temperature to be restored. The instant invention, in contradistinction to the above, has as one feature thereof energy storage means capable of storing energy from a rotating shaft which will, at a desired time, release such stored energy so that rotation of a disc or similar means is initiated in the same direction as that of the shaft.

Accordingly, it is an object of the present invention to provide an improved switch operating mechanism.

Another object is to provide a switch operating mechanism controlled by the position of a driven object.

It is a further object to provide a cutoff switch which will be returned to its normal operating condition by energy stored within the switch mechanism.

Still a further object is to provide a spring operated motion termination switch with a positive reset feature.

Yet another object is to provide a reset switch with increased reliability of operation.

Still another object is to provide a reset switch actuation mechanism that is independent of the inertial energy of the controlled device.

Other objects of this invention will become apparent upon a more comprehensive understanding of the invention for which reference is made to the following specification and drawings which describe illustrative embodiments of the invention and wherein:

FIG. 1 is a plan view of one embodiment of the instant invention shown in partial cross section along the line A—A of FIG. 2; and

FIG. 2 is a side view of the embodiment illustrated in FIG. 1.

Referring now to the drawings wherein like reference numerals refer to like or similar parts in the figures, and more particularly to FIG. 1, there is illustrated one embodiment of the instant invention. A shaft **10** is illustrated which extends to motor **17** through driven member **18**, which may be a tape recorder or other device that it is desired to stop at a particular angular position or after the shaft has rotated a predetermined period of time.

The motor 17 may be provided with suitable control means, as are shown in the illustrative embodiment, which include relay 28 and switch 30. The relay, which is used to initiate motor operation, includes a pair of normally open contacts wired in series with the motor power circuit 19, a holding winding 37 and a setting winding 29. The holding winding 37 is also wired in series with the power circuit 19 so that when a momentary pulse is received by setting winding 29 the relay will be caused to close and current flowing in the power circuit through holding winding 37 will maintain the relay in a closed position until the power circuit is interrupted. Any momentary interruption in power circuit 19 will cause relay 28 to open. This relay will then remain open until another pulse is received by setting winding 29. The switch 30, which is also in series with the power circuit, may be a normally closed push button type microswitch which when actuated will open power circuit 19. It will be realized that the relay 28 and switch 30, cooperating with each other, will allow a cycle of operation to be initiated when a pulse is applied to setting winding 29 of the relay 28, which operation will continue until switch 30 is momentarily opened. Of course, for proper operation, it is imperative that the normally closed switch 30 be returned to its closed position after the circuit is broken to permit a new pulse at the setting winding to recycle the apparatus.

A disc or cup shaped member 11 is rotatably mounted on shaft 10 by means of ball bearing assemblies 12 and 13 so that it will freely rotate with respect thereto. On the extreme lower end of shaft 10, and below the cup shaped member 11, a rotor arm 14 is rigidly mounted by means of set screws 15 and 16 so that it rotates with shaft 10. The configuration of rotor arm 14 may be more clearly appreciated by simultaneous reference to FIG. 2. It will be noted that the outer end of the rotor arm is angled so that the leading edge, as the shaft rotates in a clockwise manner, does not extend quite to the inner diameter of cup member 11. The trailing edge, however, extends beyond the outer diameter of the cup member.

As may be seen in FIG. 2, a coil spring 20 (not shown in FIG. 1 for purposes of clarity) is positioned within cup member 11 with one end fixedly mounted thereto by suitable means at 21. The other end of spring 20 is attached to shaft 10 through rotor arm 14 by means of pin 22. The structure as thus far described consists of a driven shaft with arm 14 rigidly mounted thereto and cup member 11 mounted thereon and constrained from free rotation only by means of coil spring 20 which semirigidly attaches cup member 11 to shaft 10.

Along one side of the cup member 11 a slot 23 is machined therein to receive the keyed extension of stop member 24 which is pivotably mounted by means of screw 25 to base assembly 27. A spring 26, best illustrated in FIG. 1, is attached to stop member 24 and the base assembly 27 so that the stop member is held against the outer surface of the cup member as it rotates and so that the keyed extension thereof will be drawn in to slot 23 when they are aligned.

A push button type microswitch 30, which is connected through electrical leads 19 to open the power circuit of motor 17, is adjustably attached to base member 27 by means of screws 32 and 33. Push button 31 extends from the main switch body 30, which is positioned adjacent to lever arm 34. The lever arm 34 is pivotably mounted to the base member 27 by means of screw 35 so that lever arm movement from left to right as viewed in FIG. 2 will depress push button 31 to within a few thousandths of an inch of its limit of travel and cause switch 30 to be actuated thus opening circuit 19.

Cam 36 is positioned on the outer surface of cup member 11 so that when stop member 24 is in slot 23 the lower, or forward, end of the cam will almost touch the upper end of lever arm 34 and so that further movement of the cup member 11 in a clockwise direction will cause cam 36 to depress lever arm 34 which in turn actuates switch mechanism 30.

The instant invention may be most clearly understood by considering a complete cycle of operation. Assume that shaft 10 and cup member 11 are in such a position that stop member 24 is not engaged in slot 23 and, therefore, that the cup member will rotate with the shaft due to the connecting spring 20. As the shaft rotates, and spring 20 rotates the cup member at the same rate, stop member 24 will slide along the outer surface of the cup. When slot 23 is aligned with the keyed extension on stop member 24, the spring 26 will draw the key into slot 23 preventing further rotation of the cup member. Thus, as the shaft 10 continues to rotate in a clockwise manner spring 20 will be wound so that mechanical energy is stored therein. As the shaft rotates further, the end of arm 14 will slide under stop lever 24 and as the trailing edge of the rotor arm passes thereunder the cup 11 will be freed from stop lever 24. At this time coil spring 20 will impart rotational movement to the cup member in a clockwise direction. The cam 36, which is positioned so that it is located adjacent lever arm 34 when the key is engaged in slot 23, will now depress the arm 34 actuating switch mechanism 30. The spring is selected so that it is sufficient to cause cam 36 to actuate the switch mechanism and continue to rotate far enough to permit lever arm 34 to return to the normal position. The push button 31, which is spring loaded to the outer position, also returns to its normal condition. This momentary opening of power circuit 19 will permit holding relay 28 to open thus maintaining the motor in an off condition. However, when the next pulse is received at a winding 29 the mechanism will be in condition to recycle.

Arm 14 may be adjusted by means of set screws 15 and 16 so that any selected angular position of shaft 10 will initiate the above described sequence of operation. Thus, it will be appreciated that when shaft 10 reaches a predetermined angular position it will trip stop lever 24 which will trigger an operational sequence that will actuate a switch which may be utilized to open the power circuit supplying the drive mechanism for shaft 10 and which after this operation is effectuated will, in a definite and positive manner, allow the switch to return to its normal operative position so that a second cycle may be initiated on command.

While the particular switch mechanism disclosed herein has been described in conjunction with specific embodiments for accomplishing the desired operation, it should be understood that the invention is not limited to any particular mechanical components but rather comprehends the utilization of any of a number of well-known means for accomplishing the desired effect.

What is claimed is:

1. A switch actuation mechanism, comprising in combination, switching means, a driven shaft, disc means mounted for rotation on said shaft and connected thereto by spring means, means mounted on said disc for actuating said switching means as said disc rotates on said shaft, restraining means adjacent said disc for maintaining said disc in a fixed position so that the rotation of said driven shaft will store energy in said spring means and trigger means carried by said driven shaft for releasing said restraining means at a predetermined angular position of said driven shaft.

2. A switch actuation mechanism, comprising, switching means, a driven shaft, a disc mounted for rotation about said shaft, a coil spring connected between said disc and said shaft, a cam carried by said disc for actuating said switch as said disc rotates about said shaft, a slot in said disc, engageable keying means constrained to engagement with said slot for maintaining said disc in a fixed position as said shaft rotates so that the rotation of said driven shaft will store energy in said spring means,

and a trigger arm fixedly mounted on said shaft for disengaging said keying means at a predetermined angular position of said driven shaft.

3. A self-actuating switch mechanism including a reset feature for use with switching means having at least two switch positions, said switching means being biased to one of said switch positions, comprising in combination, a driven shaft mounted in spaced relationship to said switching means, rotatable actuator means mounted on said shaft for actuating said switching means, controllable energy storage means on said shaft for causing said actuator means to sequentially actuate and then deactuate said switching means, and control means mounted on said shaft for controlling said energy storage means.

4. A self-actuating switch mechanism including a reset feature for use with push button operated switching means, comprising in combination, a driven shaft mounted in spaced relationship to said switching means, rotatable controllable energy storage means mounted on said shaft for causing self-rotation about said shaft, control means fixedly positioned on said shaft for controlling said energy storage means in response to the angular position of said shaft, and a cam mounted on said energy storage means for depressing said push button on said switching means when said energy storage means rotates about said shaft.

5. A self-actuating switch mechanism including a reset feature for use with a push-button switch, comprising in combination, a driven shaft mounted in spaced relationship to said push button switch, a spring loaded disc rotatably mounted on said shaft, controllable means for restraining rotation of said disc, a cam positioned on said disc to engage said push button as said disc rotates about said shaft, and control means fixedly positioned on said shaft to release said restraining means according to the angular position of said shaft whereby the rotation of said shaft will wind said spring until said shaft reaches a predetermined angular position when said control means will release said disc and said spring will cause said cam positioned on said disc to depress and then release said push button.

6. A motor control mechanism, comprising, a motor, a power circuit for said motor, switching means connected in series with said power circuit, a shaft driven by said motor, energy storage means interposed between said switching means and said shaft operable to actuate said switching means, trigger means connected to said shaft for controlling the operation of said storage means according to the angular position of said motor whereby energy imparted by said shaft will be stored in said energy storage means until released by said trigger means to actuate said switching means connected in said power circuit.

7. A switch actuation mechanism comprising in combination, switching means, a driven shaft which is controlled by said switching means, disc means with means located thereon for actuating said switching means, spring means connected to said driven shaft and to said disc means so that said disc means will rotate with said driven shaft, restraining means for maintaining said disc means in a fixed position with said fixed position being such that any further rotation of said disc will cause said actuation means to actuate said switching means, and trigger means carried by said driven shaft for releasing said restraining means at a predetermined angular position of said driven shaft whereby the energy stored in said spring means will rotate said disc means which will actuate said switching means and stop the rotation of said driven shaft.

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