



1

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## GRAVITY ACTUATED DELAY TIMER

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

This invention relates to timers and more particularly to improvements in time delay apparatus for actuating switches at predetermined time intervals subsequent to the occurrence of an initial signal or event.

One of the objects of the invention is to provide timing apparatus of the class referred to which is simplified in construction yet highly accurate and dependable.

Another object is to time the actuation of one or more switches by a falling weight which is attenuated in its rate of fall by the polar moment of inertia of a flywheel which is rotated by the weight.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a side elevation of the subject of the invention, portions being broken out and others broken away; and

Fig. 2 is a section taken on line 2—2, Fig. 1, portions being broken away.

Referring in detail to the drawing, the invention comprises a rigid frame having a base 10, upstanding legs 11, 12, 13, 14 welded or otherwise secured at their lower ends to the base, and a tie plate 15 similarly secured to the upper ends of the legs.

Shafts 16, 17, 18, 19 are affixed to the respective legs and rotatably support knife edge disks 20, 21, 22, 23, respectively, on conventional anti-friction bearings, such as ball bearings, enclosed in the disk hubs. Disks 20, 22 constitute a first supporting pair and disks 21, 23 constitute a second supporting pair for the ends of a shaft 24 which rests on the pairs, this construction being in substance the same as that employed for statically balancing shafts or the like.

A flywheel 25 is affixed to shaft 24 and adapted to be rotated by a flexible cable 26 which extends about the periphery of the flywheel, one end of the cable having a weight 27 affixed thereto and the other end having a loop 28 which engages a pin 29 carried by the flywheel.

A lever 30 is pivotally supported by a frame carried bracket 31 and is retained in the full line position by an electromagnet 32 which attracts one end of the lever. The other end of the lever is provided with a latch or sear 33 which engages pin 29 and prevents rotation of the flywheel. When the electromagnet is deenergized spring 34 rotates the lever to the dotted position disengaging the latch from the pin and releasing the flywheel for rotation.

Flywheel 25 is provided with a plate 35 which may be adjusted angularly about the axis of the flywheel to any desired position and locked thereat by a bolt 36 which extends through an arcuate slot 37 and threadedly engages any of a plurality of threaded apertures 38 in one face

2

of the flywheel. A projecting pin 39 is affixed to the plate, and a switch actuator 40, which operates a switch 41, is disposed in the circular path of movement of pin 39 so that when pin 39 engages actuator 40, switch 41 is operated to energize or deenergize an electrical circuit.

The flywheel is indexed in degrees of arc and empirically calibrated so that the time of rotation from rest through a desired angle may be determined from a graph wherein time is plotted against angle of rotation. The desired delay time interval for actuating the switch 40, after latch 32 is released, is then found on the graph and the angle corresponding thereto. Plate 35 is then adjusted so that pin 39 is disposed at this angle from a point at which switch actuator 40 will be actuated by pin 39, which is illustrated as angle A. When latch 32 is released from engagement with pin 29, weight 27 rotates the flywheel and at a predetermined time after release of the flywheel switch 41 will be actuated.

While only a single pin 39 has been illustrated to simplify the drawing it will be apparent that a duplicate plate 35 and pin 39 may be provided on the opposite face of the flywheel to operate a second switch at a time interval before or after actuation of switch 41. Alternatively, a plurality of switches may be disposed at various angular positions in the path of movement of pin 39 and all of these switches be sequentially operated by the single pin.

One type of switch which has been found especially effective is a fixed brittle carbon rod which is disposed within the path of pin 39 and is broken by the pin striking same, the rod being in a circuit which it is desired to deenergize. If it is desired to energize a circuit, carbon rods with spaced ends may be employed in the circuit. When pin 39 passes between these ends it simultaneously engages both rods and establishes a circuit therebetween. Its continued movement then breaks the rods. Any other suitable switch means may be employed, however, the specific switch means per se forming no part of the invention.

When it is desired to actuate a circuit at a time interval which would require in excess of one revolution of the flywheel a similar plate 35a, carrying a pin 39a, is secured to one of the disks, such as disk 20 with pin 39a disposed at a desired angle, such as angle B, from a switch actuator 40a which actuates a switch 41a. When latch 32 releases the flywheel the latter accelerates until weight 27 strikes base or platform 10 after which the flywheel is in a state of free spin at very gradually decreasing angular velocity. Loop 28 automatically releases its engagement with pin 29 when the weight strikes the platform. Due to the large difference in diameters of shaft 24 and disk 20 it will be apparent that disk 20 rotates at an angular velocity which is directly proportional to the diameters of the shaft and disk. Thus, pin 39a may actuate switch actuator 40a after the flywheel has rotated a number of revolutions. As will be apparent, the setting of an angle, such as angle B, is found from a graph which has been plotted from empirically determined data. As will also be apparent, pin 39a may sequentially actuate a plurality of switches, such as switch 41a, and similar pins may be provided on the other disks if desired.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A timing device comprising a shaft, a flywheel affixed to the shaft, pairs of spaced rotatably supported disks disposed at opposite sides of the flywheel, each pair frictionally engaging the shaft and supporting same for

3

rotation thereon, the disks being rotatable in response to rotation of the flywheel and shaft, at an angular velocity less than that of the shaft, a flexible member trained about the periphery of the flywheel having one end detachably connected to the flywheel, a weight suspended by the other end of the flexible member, an arresting platform adapted to arrest movement of the weight as it descends in response to gravitational force, latching means for latching the flywheel against rotation with the weight disposed above the platform, means for releasing the latching means to permit the weight to angularly accelerate the flywheel as the weight descends toward the platform, the first named end of the flexible member being detachable from the flywheel in response to engagement of the weight with the platform, whereby the flywheel may thereafter spin with the energy imparted thereto by the weight, and angularly movable electric switch actuator means driven at a desired angular velocity relative to the angular velocity of the flywheel adapted to actuate an electric switch at a predetermined time interval after actuation of the means for releasing the latching means.

2. Apparatus in accordance with claim 1 wherein said switch actuator is carried by the flywheel.

3. Apparatus in accordance with claim 1 wherein said switch actuator is carried by one of the disks.

4. Apparatus in accordance with claim 1 wherein said switch actuator is carried by the flywheel; and another similar actuator carried by one of the disks.

5. An electric timing device comprising: a flywheel mounted for rotation by a shaft carrying same, the shaft

4

being supported by pairs of spaced rotatable supporting disks frictionally engaging same, a gravity actuated weight operatively connected to the flywheel adapted to angularly accelerate same, the free fall of the weight being principally attenuated by the polar moment of inertia of the flywheel, whereby the weight falls at a rate less than its rate of free fall, releasable means for preventing rotation of the flywheel at a certain initial reference position, and switch actuator means driven at a predetermined ratio to the speed of rotation of the flywheel adapted to actuate a switch at a preselected time interval after the releasable means is actuated to permit rotation of the flywheel.

6. Apparatus in accordance with claim 5 wherein said actuator means is carried by the flywheel and rotates at the same angular velocity thereof.

7. Apparatus in accordance with claim 5 wherein said actuator means is carried by a member adapted to be rotated by the flywheel at an angular velocity less than that of the flywheel.

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