March 2, 1965 A. K. BREED 3,171,245

DASHPOT TIMER

Filed Feb. 25, 1963 4 Sheets-Sheet 1

FIG. 1

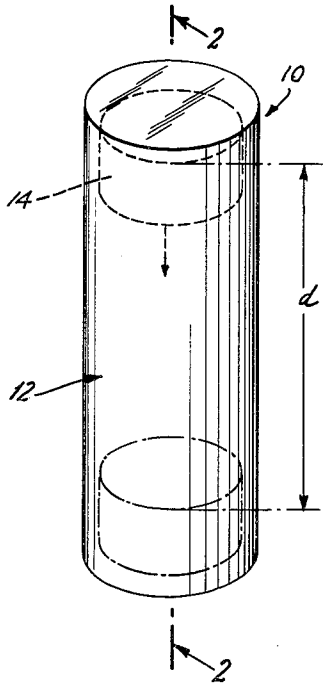
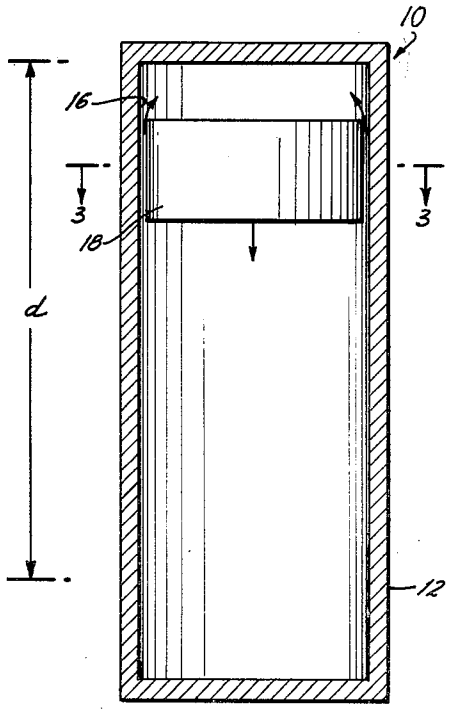


FIG. 2



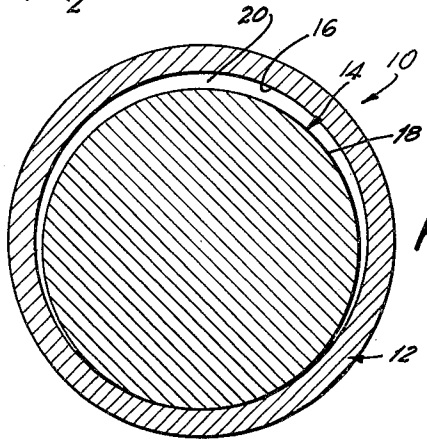


FIG. 3

INVENTOR.
ALLEN K. BREED

BY

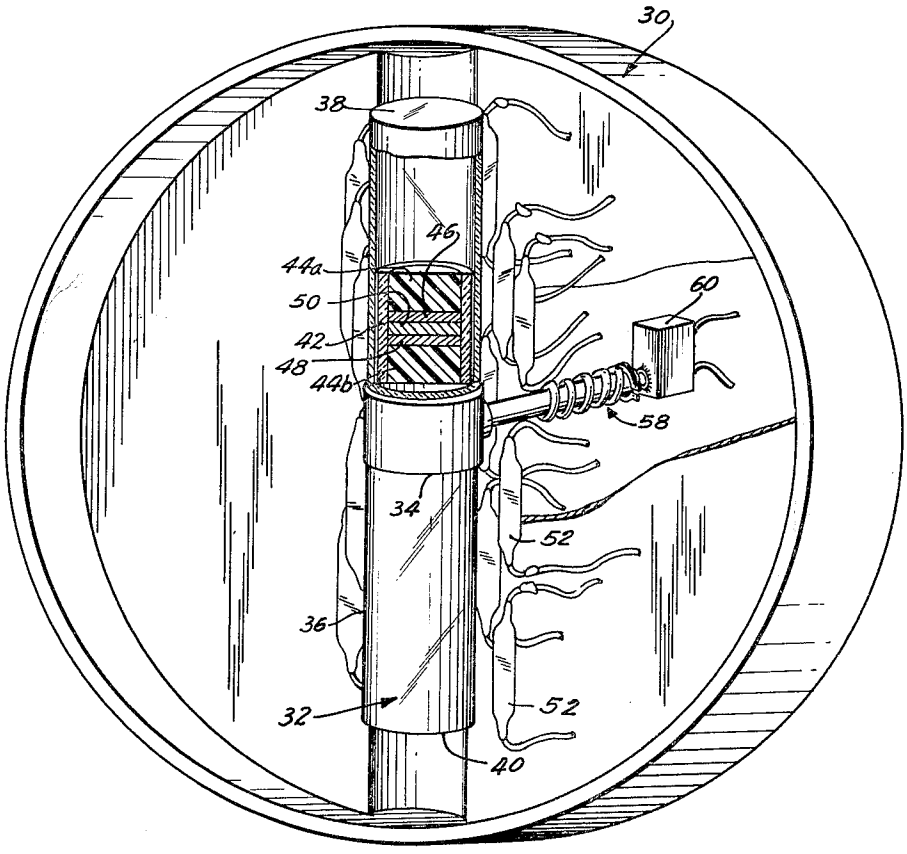
Kane, Dalsimer and Kane
ATTORNEYS

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DASHPOT TIMER

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FIG. 4



INVENTOR.
ALLEN K. BREED

BY

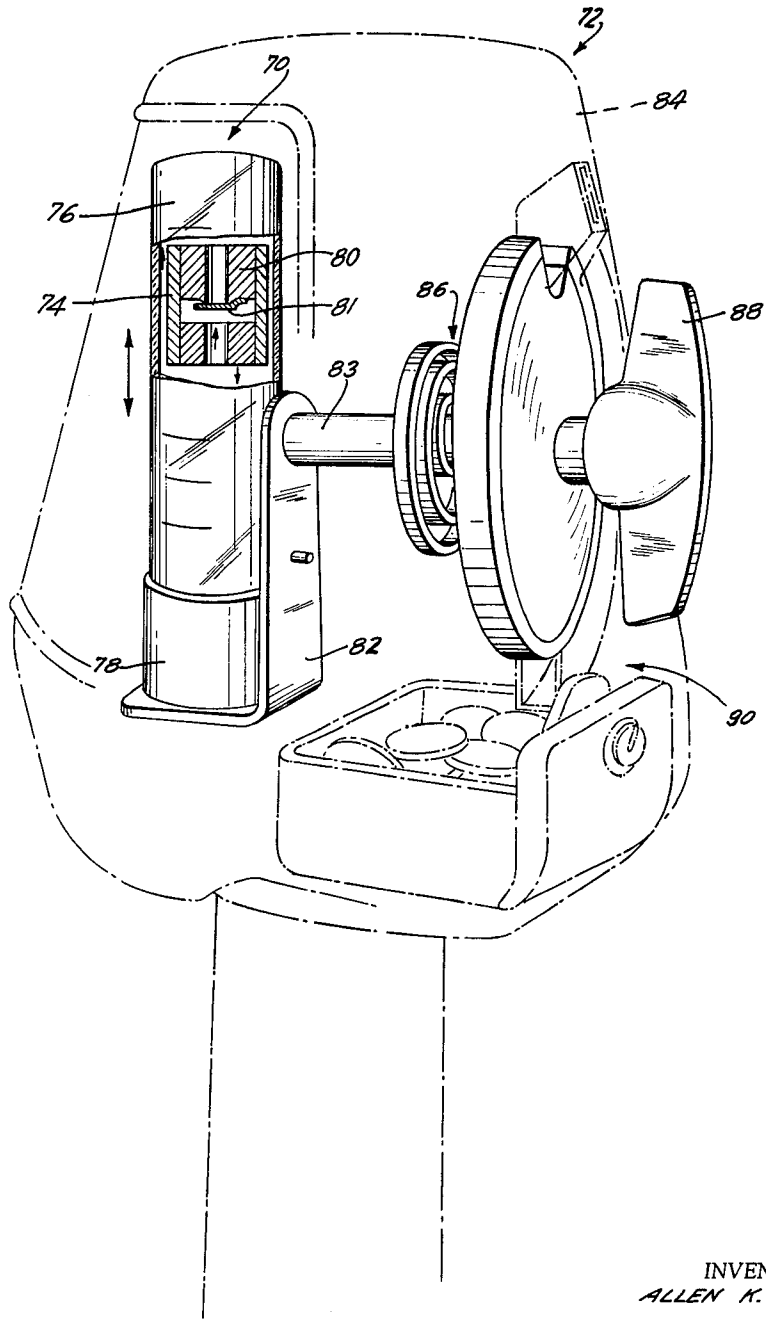
Kane, Dalsimer and Kane
ATTORNEYS

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DASHPOT TIMER

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FIG. 5



INVENTOR.
ALLEN K. BREED

BY

Kane, Dalsimer and Kane
ATTORNEYS

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DASHPOT TIMER

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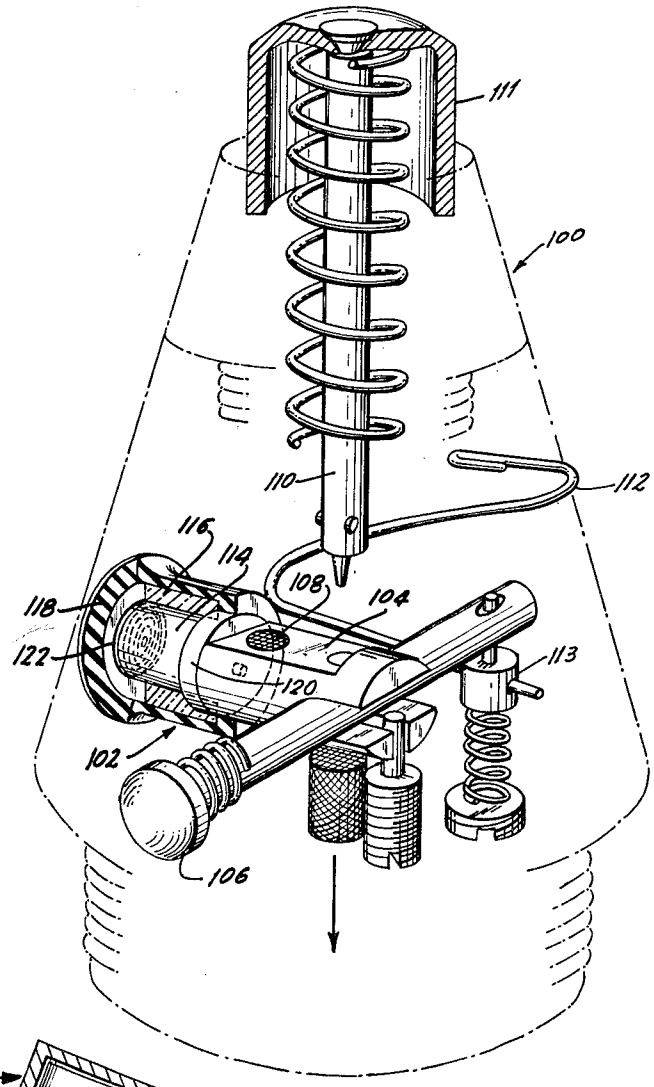


FIG. 6

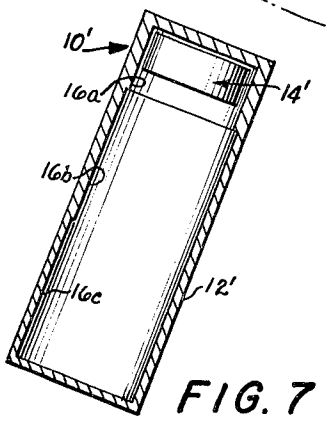


FIG. 7

INVENTOR.
ALLEN K. BREED

BY

Kane, Dalsimer and Kane
ATTORNEYS

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3,171,245

DASHPOT TIMER

Allen K. Breed, Mountain Lakes, N.J., assignor to Breed Corporation, Caldwell, N.J., a corporation of New Jersey

Filed Feb. 25, 1963, Ser. No. 260,767
17 Claims. (Cl. 58—144)

The present invention relates generally to timing mechanisms and, more particularly, to a dashpot type of timer in which a piston travels in a cylinder at a controlled rate. This movement occurs due to predictable fluid flow from the forward side of the position through a predetermined annular clearance between piston and interior cylinder walls to occupy the ever increasing volume behind the piston.

Heretofore, liquid dishpots have been proposed; but they have limited application as timers because of the significant non-linear change of fluid viscosity with temperature. Sealing of the liquid in such dashpots has also created problems. Over a period of time the liquid would seep past O-rings and other sealing members. Thus, time delay accuracy and repetition is seriously affected. Some gas dashpots have had occasional applications; but their use as timers has been limited by the cost of manufacture not to mention the inability to maintain, for prolonged periods, the desired piston and cylindrical dimensional tolerances within required and prescribed limits. Similarly, time delay reproducibility is of short duration.

It is an object of the invention to eliminate the disadvantages and drawbacks of prior art dashpots and timers by providing a dashpot timer consisting of a ceramic piston and cylinder. In most of the contemplated applications of the invention, glass is the preferred ceramic.

Another object is to provide a dashpot timer that is exceptionally reliable, susceptible to long life and relatively inexpensive to manufacture.

A further object is to apply such timers to:

(*a*) Numerous mechanisms now employing electrical synchronous motors, mechanical escapements or conventional fluid dashpots.

(*b*) Sequential programming devices, such as home automatic washing machines, wherein electric switches are opened and closed in a timed sequence, automatic traffic signal programmers, and time delayed electric switching of all types.

(*c*) Visual timer indicators wherein an elapsed period of time is visually indicated such as in the case with automobile parking meters as well as cooking timers as, for example, a three-minute egg timer.

(*d*) Timing mechanisms having a mechanical output the energy of which may be required at the conclusion of a preset time interval for the performance of work such as the initiation of an explosive primer or train or the physical alignment of a detonator for arming ordinance shells, missiles and projectiles as well as bombs.

Still another object is to produce a dashpot timer employing a glass cylinder and piston having their respective mating diameters very closely dimensionally controlled to provide a know clearance in the form of an annular orifice through which a known amount of gas must pass from beginning to end of the prescribed time interval which may range from less than one hundredth of a second to more than several days.

A still further object is to provide a dashpot timer having a glass cylinder and piston offering the following advantages:

(1) The adaptation of low cost, large volume production techniques for producting glass cylinders capable of

providing relatively accurate internal diameters and, in the case of piston construction, relatively accurate outside diameters, the dimensional accuracy for volume production being in terms of millionths of an inch.

(2) The utilization of the superior wear characteristics after repeated timing cycles as exhibited by the cooperating glass surface thereby rendering it possible to obtain time delay reproducibility over prolonged periods.

(3) The preclusion of accidentally formed raised burrs during manufacture or the operational life of the timer because of reliance to advantage of the brittle nature of glass.

(4) The use of the excellent dimensional stability of annealed glass and permissible dimensional precision between piston and cylinder thereby resulting in the desired accuracy and reproducibility.

(5) The employment of the corrosion resistance properties of glass to long term atmospheric exposure as well as most corrosive chemicals thereby assuring precision fit between piston and cylinder over prolonged periods of operation.

(6) The ability to readily hermetically seal the glass cylinder and introduce therein an inert, moisture-free, gaseous medium for the production of dashpot times completely unaffected by atmospheric or ambient conditions.

(7) The ability to effectively employ the relatively low thermal coefficients of expansion of glass as well as the availability of glasses having slightly different coefficients of expansion in order to afford a means of compensating for timed interval changes caused by changes in gas viscosity with temperature.

(8) The ability to couple magnetically through glass, permits the actuation of electrical switches, the generation of an electric current and other types of energy transfer or responses from with a hermetically sealed cylinder to external parts and mechanisms.

(9) The visual indication of the expiration of a timed interval as indicated within a hermetically sealed glass cylinder because of the transparent nature of such material.

Other objects and advantages will become apparent from the following detailed description which is to be taken in conjunction with the accompanying drawings illustrating exemplary preferred embodiments of the invention and in which:

FIG. 1 is a perspective view of a dashpot timer incorporating the teachings of the present invention;

FIG. 2 is a longitudinal sectional view thereof;

FIG. 3 is a cross sectional view taken along the line 3—3 of FIG. 2;

FIG. 4 is a fragmentary schematic perspective view of a washing machine programmer employing a timing capsule of this invention;

FIG. 5 is a fragmentary schematic perspective view of a parking meter employing a timing capsule of this invention;

FIG. 6 is a fragmentary schematic perspective view of a mortar fuse employing a timing capsule of this invention and;

FIG. 7 is a longitudinal sectional view of a timer in accordance with this invention in which the cylinder is at an acute angle with respect to the horizontal and the clearance between the piston and cylinder is varied along the length of the cylinder to permit different rates of piston travel.

In FIGURES 1 to 3, a timer **10** is illustrated incorporating the teachings of the present invention. This timer **10** includes a cylinder **12** in which a piston **14** is slidably disposed. The dimensional tolerances of the interior wall

16 of the cylinder 12 and exterior wall 18 of the piston 14 provide for an annular orifice 20 through which a fluid, in gaseous form, is adapted to flow. In other words, the glass cylinder 12 and glass piston 14 have their mating diameters, represented by the respective walls 16 and 18, very closely dimensionally controlled to provide a known clearance 20 through which a known amount of gas must pass from the beginning to end of the prescribed time interval (represented by the length of longitudinal travel of the piston 14 in cylinder 12 by the letter *d*). In this connection, at least one of the cylinder ends is sealed to assure fluid flow through the orifice 20. Certain applications will provide for the sealing of either or both cylinder ends.

For a better understanding of the invention, several exemplary embodiments and applications thereof will now be discussed. In the first instance, reference is now made to the proposed washing machine programmer of FIG. 4 wherein magnetic coupling is employed between a piston contained in a hermetically sealed cylinder and an external electrical network. By making and breaking electric contacts in a specified sequence, a program timer causes an automatic home appliance to go through its work cycle. Such program timers are also used in colthes dryers and dishwashers. All known program timers currently in use consist of a synchronous motor driving a cam shaft which causes the desired sequence of contact closures. Additional mechanisms are usually employed to cause incremental movement of the cam shaft to minimize contact arcing. Program timer failure is probably the greatest single reason for service calls.

In a programmer 30 incorporating the teachings of this invention, the timing capsule 32 is conveniently mounted for pivotal and transverse linear movement by means of the centrally located capsule holder or band 34. The timing capsule 32 includes a glass cylinder 36 hermetically sealed at each of its ends 38 and 40. The interior of the sealed cylinder 36 is preferably filled with an inert gas such as argon. A piston 42 is mounted interiorly of the cylinder 36 both of which provide a prescribed clearance for passage therebetween of the inert gas. A plug 44 of either metal or suitable resinous material extends across the internal diameter of the piston 42 in a completely sealed manner. In gravity operated programmer timing capsules, the weight of this plug 44 is deliberately selected for purposes of adjusting the lapsed time or time delay. A pair of disk shaped magnets 46 and 48 are secured to the piston 52. These magnets 46 and 48 are polarized on an axis coincident with that of the cylinder 36 so that their like poles are adjacent. A disk 50 preferably formed from a mild steel is interposed between the magnetic disks 46 and 48 for purposes of concentrating the established magnetic field.

A series of reed switches 52 are suitably mounted in proximity to the cylinder 36. Under such circumstances, they are adapted to be excited by the concentrated magnetic field generated by means of the disks 46, 48 and 50. These switches are located with respect to the path of descent of the piston 42 such that they are excited or actuated for purposes of opening and closing electrical circuitry at the end and start of the particular cycles of operation to be controlled by the programmer 30. For example, the opening and closing of the reed switches 52 serve to turn on and off the appliance as well as start and stop, in the case of a washing machine, the wash, spin, rinse and dry cycles.

The cylinder can be rotated in a vertical plane with a spring detent assembly 58 serving to urge the timing capsule 32 and specifically the axis of the cylinder 36, in a substantially vertical position. In addition, the timing capsule 32 is permitted a relatively short in-and-out transverse motion when the timing capsule 32 is vertical for purposes of actuating the main power switch 60 to turn on the appliance. When the glass cylinder 36 is other than vertical, the appropriate shaft configuration of

the spring detent assembly 58 causes the appliance to be maintained in an off position.

The program sequence is started by turning the capsule 32 180° and pushing in. Gravity acting on the piston 42 as well as the other mounted parts including 44 causes the piston to fall to the bottom end 40 of the cylinder 36. The rate of this descent is determined by the flow of the contained inert gas below the piston through the annular orifice between the piston and cylinder walls to the space above. As the piston 42 travels from top to bottom, the reed switches 52 are actuated in the prescribed sequence. The cycle is completed when the piston reaches the bottom of the cylinder.

In other installations, the addition of an iron rod serving as a solenoid core may extend from the piston in a concentric manner into the interior of a solenoid coil which may be mounted either inside or outside of the glass cylinder as another means of applying a force to the piston. In still other applications, a coil spring within the cylinder acting on the piston will prove satisfactory to the action desired. In an alternative arrangement, the piston plug may include a one-way valve to thereby provide a means for rapidly returning the piston to its starting point by rotating the timing capsule 180° and then back.

Thus, it will be clear that the above timing capsule and all switches are hermetically sealed. Magnetic coupling between the slow-moving piston and the reed switches is used to actuate the switch contacts. The relative simplicity of operation as well as the hermetic sealing of all components render the proposed programmer maintenance free for substantially longer than the life of the appliances controlled. In a specific application of the contemplated timer, a glass cylinder approximately one-inch in diameter and four inches long was hermetically sealed with glass disks at each end. Within the cylinder, a glass piston approximately five-eighths inch long having a magnetic core and associated components completed the timing capsule which performed satisfactorily.

Referring now to FIG. 5, a pneumatic annular orifice dashpot or timing capsule 70 is employed in a parking meter 72. This proposed meter, during the registration of elapsed time, has only one moving part, namely, the piston 74 advantageously mounted interiorly of the cylinder 76. Under such circumstances, the descent of the piston 74 actually serves as the elapsed time indicator. The cylinder 76 is hermetically sealed at both ends while containing the particular choice of gaseous medium. Once again, the inert gaseous medium may be argon. In geographical locations subject to a wide temperature range, a fluid may be selected with a viscosity affected by temperature to a lesser extent. On the other hand, as indicated above, a difference in the coefficient of expansion between the piston and cylinder glass may be selected such that the change in annular orifice with temperature offsets the change in viscosity of gaseous medium over a corresponding temperature change.

The piston may be brightly colored to indicate that the elapsed time has not reached the expiration point at which time the piston 74 may be completely hidden from view by means of the shield 78 located at the base of the cylinder 76. The piston 74 includes an internal plug 80, the weight of which may contribute to the desired rate of descent of the piston. A one-way valve 81 is mounted interiorly of the plug 80 so that when it is desired to reset the timing capsule 70, the piston 74 together with plug 80 will rapidly fall to the top of the cylinder 76. In this connection, a shaft 83 is coupled, at the midpoint of the cylinder 76 as, for example, by means of a band and is rotatably journaled by angle bracket 82 secured interiorly of the meter housing 84. A return spring mechanism 86 serves to maintain the timing capsule 70 in a substantially vertical position and at a particular orientation at all times. The outer end of the shaft 83 extends through the meter housing 84 and mounts the

turning knob 88 which cooperates in resetting the timing capsule 70. The cylinder 76 is thusly rotated 180° about the axis of the shaft 83 in a vertical plane and then permitted to return to its initial position under the action of the return spring mechanism 86. This movement causes the piston 74 through the opening of the one-way check valve 81 to fall rapidly to the top of the cylinder.

In the suggested application of this embodiment to automobile parking meters, setting of the timing capsule 70 is regulated by means of a coin release mechanism 90 which may be of any construction as, for example, that present in commercially available parking meters.

The functional simplicity and hermatic sealing of the timing unit 70 in the parking meter application eliminates maintenance over prolonged periods of operation heretofore unrealized. In a particular application of this embodiment, a glass cylinder one inch in diameter and five inches long was sealed at each end with a contained piston. This piston was provided with a weighted core and check valve. As explained, this valve will allow rapid movement of the piston upwardly to the top of the cylinder; whereas downward movement of the piston proceeds at a rate determined by the flow of air or gas around the piston through the deliberately provided annular orifice between piston and cylinder. The piston was colored green with five minute lines stained or otherwise provided on the glass cylinder to indicate the time remaining. The green piston would fall below the view window in the parking meter when the time has expired. On the other hand, if a red expired indication is preferred, the piston would be colored red with only the bottom portion of the cylinder being visible through the meter viewing window. The red piston would rapidly move into view at the expiration of the metered time.

Ordnance and military applications for the timer of this invention are contemplated particularly in the area of fuses and safety and arming devices. For example, the pneumatic annular orifice dashpot of this invention can be incorporated into the M–52 Mortar Fuse to provide a minimum two second arming delay therefor. Functional reliability, after long term storage in corrosive atmospheres, ease of renovating existing fuse stocks and greater economy to army ordnance renders this approach far superior to the escapement mechanisms currently being utilized. In FIG. 6, the conventional military mortar fuse 100, identified in the above, contains a timing capsule 102 of this invention. In the conventional fuse, release of the slider 104 by the bore riding pin 106 as the projectile emerges from the mortar tube permits the standard coil spring (removed from the illustrated fuse and replaced by the timing capsule 102) to immediately move the slider 104 to thereby align the detonator 108. The detonator or striker pen 110 will, under such circumstances, be in a position to ignite the powder or explosive train upon contact or impact of the fuse head 111. As will be appreciated by those skilled in the art, the pin 106 is released by removing the safety pull cord prior to dropping the mortar in the tube. Upon acceleration of the mortar, the inertial block 13 is set back against its associated spring to permit the pin to be released radially upon leaving the tube under the influence of its associated spring.

Replacement of the standard coil spring by the timing capsule 102 of this invention causes the slider 104 to move only at a rate at which air or other gas can flow throught he clearance between the glass piston 114 and cylinder 116. A several second arming delay is thus achieved. The timing capsule 102 may be conveniently mounted in a silicone rubber holder 118, with the piston suitably mounting a silicone rubber piston plug 120 for engaging the slider 104. A compression spring 122 compressible into a plane the thickness of the wire serves to create or generate the necessary bias for moving the piston 114 in the cylinder 116.

Thus, adaptation of the timing capsule 102 to the fuse 100 merely consists of the replacement of the slider spring with a capsule approximately one-half inch in diameter and one-third of an inch long. No change in external fuse dimensions is necessary. Operation of the fuse incorporating the capsule 102 is substantially identical with the exception that, when the bore riding pin 106 releases the slider 104 as the round clears the mortar tube, the detonator 108 is not immediately sligned. To the contrary, a minimum of two seconds is required for the first part of the travel of the piston 114 and, consequently, the slider 104. This two second delay is represented by approximately .135 inch of travel of the piston. At this point, the piston 114 emerges from the cylinder 116 and immediate detonator 108 alignment occurs.

In a similar application, the timing capsule of the present invention may be adapted to provide, for example, a 300 foot arming distance for artillery ammunition. This safe distance isa chieved by delaying detonator alignment proportional to round velocity from .1 to .6 second. The superiority of this proposal, as compared to the standard escapement mechanisms, has been discussed and is, otherwise, readily obvious.

Other applications of the timing capsule of this invention include integrating accelerometers which provide for switch closure at the end of a predetermined acceleration stimuli; home timers capable of registry for practically any time; time delay switches whereby electric switch contacts are opened or closed following the expiration of a given time period after start of the delay cycle; a timer in the minute range capable of being mounted on the eraser end of a conventional mechanical pencil or ball point pen; arming delay, impact sensitive time delay hand grenade fuses; anti-tank safety and arming delay detonator fuse; acceleration integration for drop-safe setback systems and rotor alignment delays in safety and arming devices and ordnance fuses; loger arming delays and, consequently, greater safe distance for ammunition clearing the weapon chamber; noiseless time bombs; and detonation of an explosive ammunition around after the elapse of a predetermined time period following launching.

In the timing capsule and their particular applications, provide the force actuating on the piston thereby inducing it to travel in the supporting cylinder. Some applications permit the hermetic sealing of the glass cylinder ends particularly where visual observation or magnetic coupling to the piston fulfills the purpose of the timing capsule. Still other applications provide for the sealing of the cylinder interior or the capsule itself from the atmosphere by means of flexible rubber membranes or rubber to glasss pressure seals. A check valve on the piston is appropriate in several instances where rapid movement of the piston in one direction is required. In devices where electric switch closurei s desired, a magnetic core in the piston is employed for actuation of a hermetically sealed glass enclosed reed switch located outside of a hermetically sealed cylinder. In such applications, a magnetic piston core may cooperate in providing for piston movement in the cylinder by means of its attraction to an external magnet. In practically all applications, molded silicone rubber cushions the glass parts from the other components. Naturally, other suitable material for such purposes can be employed.

As explained in the foregoing, temperature changes which, in turn, cause gas viscosity changes resulting in a change in elapsed time can be compensated for by having the cylinder produced from a glass having a slightly greater thermal coefficient of expansion than the piston glass as the temperature rises and the gas becomes more viscous. The greater thermal expansion of the cylinder over the piston causes an increase in the piston-cylinder clearance. This increased clearance permits the same flow rate of the thicker or higher viscosity gas as at the lower temperature thus resulting in substantially the same

rate of piston travel for elapsed time. In certain applications such as those involving electric switching, it has been found desirable to vary the cylinder internal diameter along its length to cause a different rate of piston travel at different positions. For example, such an approach may be desirable, when in a total cycle of one hour, it is desired to actuate several switches in the first few minutes with no other switching required until the conclusion of the cycle. A rapid piston travel at the beginning of the cycle would facilitate placement of the switches a convenient distance apart along the cylinder.

In other applications, very rapid movement of the piston at the end of a cycle may be desired to permit, for example, enough kinetic energy to be accumulated in the piston to initiate an explosive primer or to generate a useable electric signal by rapidly passing a piston having a magnetic plug through a coil by providing appropriate slots in the interior cylinder walls. In FIG. 7 a timer **10'** in accordance with this invention is illustrated in which the cylinder **12'** is inclined at an acute angle with respect to the horizontal so that the piston **14'** rests upon the cylinder **12'**. In addition, the clearance between the piston **14'** and cylinder **12'** is varied along the length of the cylinder **12'** to permit different rates of piston travel at predetermined locations along the path of travel of the piston **14'** in the cylinder **12'**. Thus, the cylinder **12'** is provided with an initial sector **16*a*** having a certain diameter and a second sector **16*b*** having a somewhat increased diameter for purposes of increasing the clearance of the piston **14'** and cylinder **12'** and, consequently, cause an increase in the rate of piston travel. The terminal end of this sector **16*b*** is provided with a slot **16*c*** which enables the piston **14'** to move rapidly at the end of its travel in the cylinder **12'**.

The mathematics surrounding the necessary clearance between the piston and cylinder, for a given desired time delay, will not be explored at this time for the sake of brevity. Suffice it to say, the theory of compressible fluid flow, as discussed in any well known hydraulic or fluid mechanics text, is applicable. Although the relevant equations and their derivation are readily determinable by those skilled in the art, it will, nevertheless, be interesting to note at this time that the time factor is a function of the third power of the clearance measured from the piston to the internal walls of this cylinder. Consequently, a slight change in this clearance will substantially effect the time delay. Tolerances, with respect to this variable, are, therefore, very important. The time is a linear function of the viscosity of the gaseous medium passing through the clearance. Therefore, there will be an effect on the time delay if the timing capsule is to be used over a wide temperature range. As explained in the foregoing, the effects on time of the viscosity changes and the varying clearance with temperature changes can be made to cancel almost completely.

The time delay will vary by a factor of 2.5 if the piston travels while resting against the side of the cylinder as depicted in the cross sectional view of FIG. 3 as compared to the travel of the piston while concentrically mounted with respect to the mounting cylinder. In other words, it will take 2.5 times as long for the piston to travel in the cylinder if coaxial or centralized than if resting against the side of the cylinder. However, for optimum reproducibility, it is preferred that the piston engage or rest at all times against the cylinder. This disposition of piston and cylinder can be achieved by inclining to a certain degree the cylinder or, on the other hand, providing an external force as for example, a magnetic bias for drawing the piston to one side of the cylinder. Similar means can be provided for assuring the same line of contact of piston with cylinder during each timing cycle.

Thus, the pneumatic annular orifice dashpot of this invention is capable of providing delays from tenths of a second to several hours; and either glass, silicone or equivalent material need only be employed in the fabrication of its parts. In accordance with modern manufacturing and handling techniques for glass, an ultra precision glass piston and cylinder are adapted to be fit together with an annular clearance controlled to millionths of an inch for time delays up to one hour. In order to improve frictional characteristics particularly of mating parts, the glass may be subjected to a silicone composition treatment well known in the glass bottle industry. The timing capsule of this invention can be significantly smaller than devices currently in use, this smaller size in certain instances being generally a distinct advantage. Timers that have been less than one-quarter of an inch in diameter and one-third of an inch long to greater than one and one-half inches in diameter and six inches long, have performed satisfactorily within the prescribed criteria while possessing the desired parameters. Delays less than .1 second to one minute have been found practical utilizing a unit one-half inch in diameter and one-third of an inch long with a piston travel of one-eighth of an inch.

Thus, the numerous aforenoted objects and advantages, among others, are most effectively attained. Although several preferred embodiments and applications have been described, discussed and illustrated herein, it should be understood that this invention is in no sense limited thereby but its scope is to be determined by that of the appended claims.

I claim:

1. A dashpot timer of the class described comprising a cylinder having an interior glass wall and hermetically sealed at both ends, a piston having an exterior glass wall and slidably disposed in said cylinder, the exterior glass wall of said piston being substantially cylindrical, and an inert gaseous medium completely filling the sealed interior of said cylinder.

2. The invention in accordance with claim 1 wherein said medium is Argon.

3. A pneumatic dashpot timer comprising a cylinder having an interior glass wall and having a precision internal cylindrical bore surface, said cylinder containing pneumatic fluid, a piston having an exterior glass wall and having a precision outer cylindrical surface, said cylinder and piston being so constructed and arranged such that said internal bore surface and outer cylindrical surface provide a predetermined annular clearance therebetween such that the piston travels in said cylinder at a controlled rate determined by the bleeding of the pneumatic fluid through the annular clearance.

4. The invention in accordance with claim 3 wherein said piston includes a one-way check valve for permitting rapid movement of the piston in the cylinder in one direction.

5. The invention in accordance with claim 3 wherein the clearance between the glass piston and cylinder is varied along the length of the cylinder to permit different rates of piston travel at predetermined locations along the path of travel of said piston in said cylinder.

6. The invention in accordance with claim 3 wherein at least one permanent magnet is attached to said piston, and at least one magnetically excitable electric switch is in proximity to said cylinder such that during the travel of said piston in said cylinder said magnet is adapted to excite said switch.

7. The invention in accordance with claim 3 wherein portions of said cylinder are transparent whereby a position of the piston is visible and the elapsed time from the beginning of the travel of the piston determinable.

8. The invention in accordance with claim 3 wherein an electric coil is concentrically mounted with respect to said cylinder, a solenoid core is coupled with said piston such that upon energization of said coil a force is applied to said piston through said core.

9. The invention in accordance with claim 3 wherein

a coil spring is biased against said piston for inducing said piston to travel in said cylinder.

10. The invention in accordance with claim 3 wherein means are provided for releasably holding said piston in said cylinder at a predetermined location, said means being adapted to be overcome upon the experiencing of predetermined acceleration forces to thereby permit said piston to travel in said cylinder under the influence of said forces.

11. The invention in accordance with claim 3 wherein said cylinder is at an acute angle with respect to the horizontal such that said piston rests against said cylinder.

12. The invention in accordance with claim 3 wherein magnetic means are located externally of said cylinder for causing said piston to be biased against said cylinder.

13. The invention in accordance with claim 3 wherein means are provided for incorporating said timer in a washing machine programmer.

14. The invention in accordance with claim 3 wherein means are provided for incorporating said timer in an automobile parking meter.

15. The invention in accordance with claim 3 wherein means are provided for incorporating said timer in an ordnance fuze.

16. A pneumatic dashpot timer comprising a cylinder having an interior ceramic wall and having a precision internal cylindrical bore surface, said cylinder containing pneumatic fluid, a piston having an exterior ceramic wall and having a precision outer cylindrical surface, said cylinder and piston being so constructed and arranged such that said internal bore surface and outer cylindrical surface provide a predetermined annular clearance therebetween such that the piston travels in said cylinder at a controlled rate determined by the bleeding of the pneumatic fluid through the annular clearance.

17. The invention in accordance with claim 16 wherein the ceramic of said cylinder and the ceramic of said piston possess relatively different coefficients of expansion cooperable to thereby compensate for changes in the viscosity of the fluid with ambient temperature changes.

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LEYLAND M. MARTIN, *Primary Examiner.*