Oct. 10, 1950 W. H. KUNTZ 2,525,608

BAROMETRIC CONTROL OF TIME-ACTUATORS

Filed Jan. 14, 1950 2 Sheets-Sheet 1

Fig. 1.

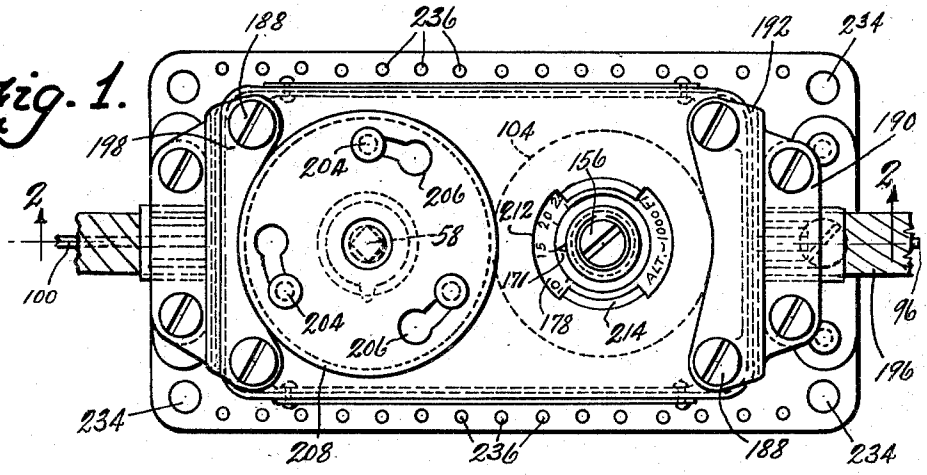


Fig. 2.

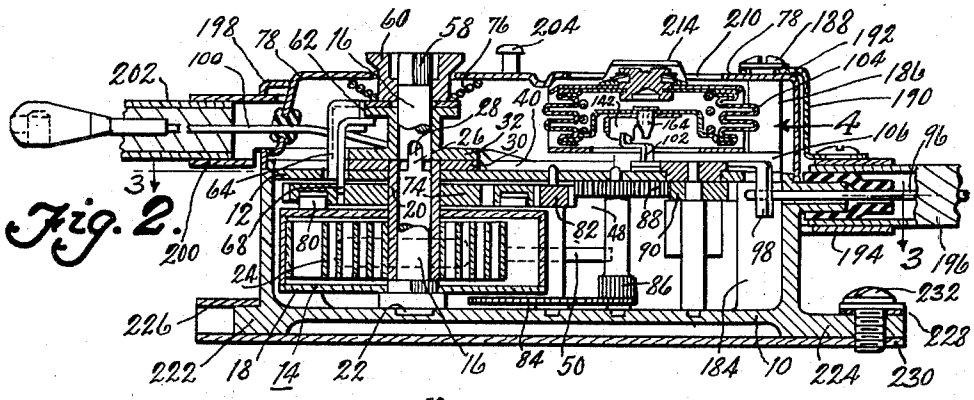
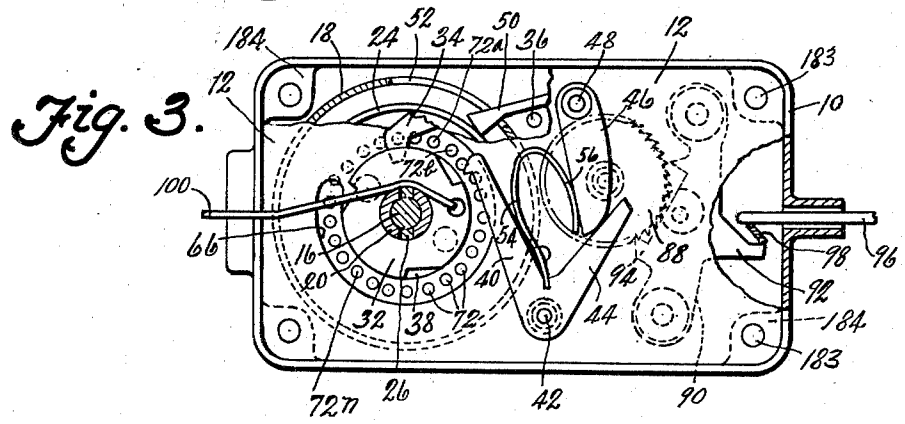


Fig. 3.



INVENTOR
WILLIAM H. KUNTZ
By Russell C. Lane
his ATTORNEY

Oct. 10, 1950 W. H. KUNTZ 2,525,608

BAROMETRIC CONTROL OF TIME-ACTUATORS

Filed Jan. 14, 1950 2 Sheets-Sheet 2

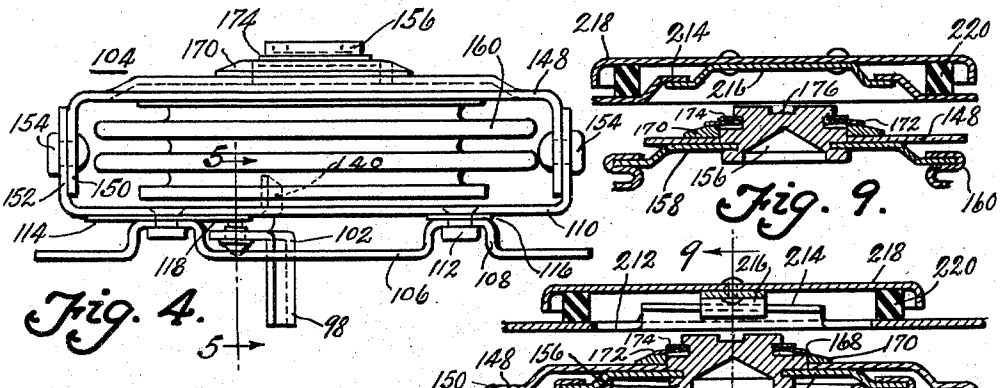


Fig. 4.

Fig. 9.

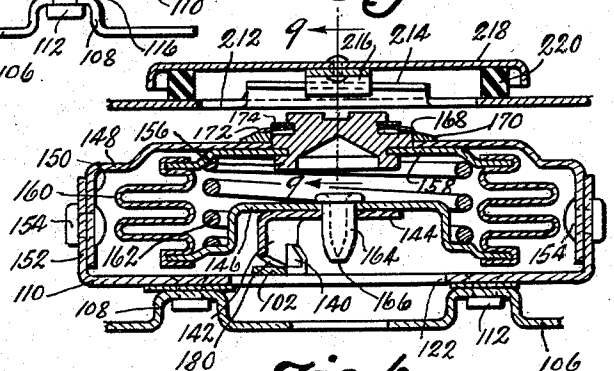


Fig. 6.

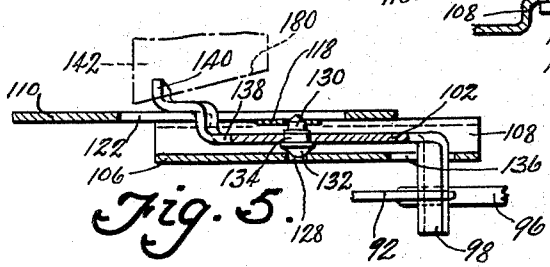


Fig. 5.

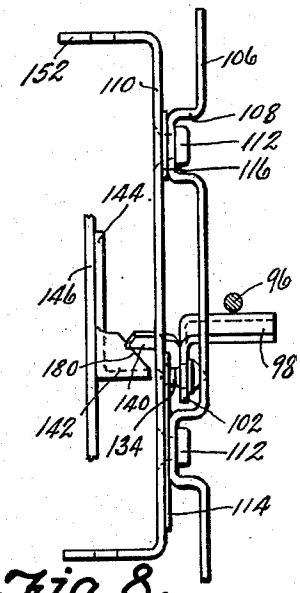


Fig. 8.

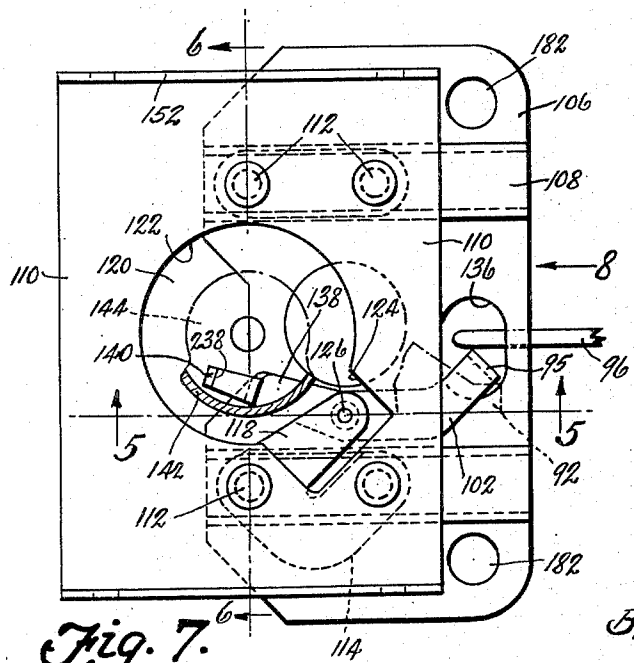


Fig. 7.

INVENTOR
WILLIAM H. KUNTZ
By Russell C. Lane
his ATTORNEY

Patented Oct. 10, 1950 2,525,608

UNITED STATES PATENT OFFICE

2,525,608

BAROMETRIC CONTROL OF TIME-ACTUATOR

William H. Kuntz, Dayton, Ohio

Application January 14, 1950, Serial No. 138,550

11 Claims. (Cl. 161—1)

1

This invention relates to a timer-actuator for setting into action a mechanism to perform a definite act at a predetermined interval of time after an intended initiation, and contemplates an additional control device for a timer-actuator device of the type disclosed and claimed in my copending application Ser. No. 66,309, filed December 20, 1948. The additional control device comprehends a barometric unit mounted within a timer actuator casing and coupled with a tripping element thereof in such manner that the final release of the driving or power developing means for actuating a selected device, is delayed until preselected conditions are experienced. The barometric control unit is a complete subassembly that fits within the timer-actuator housing and when secured in place is so mechanically coupled with the trip pin and the escapement means of the timer mechanism that the power developing means is restrained from operating, even though the trip pin is withdrawn, until a preselected set of conditions occur. Making toward that end the barometric unit has its own frame enclosing an expansible chamber whose movable wall carries a cam settable to different positions corresponding to different pressures in terms of altitude and acting as a variable detent obstructing one end of a pivoted lever having a part interposed between the release pin and an extension of an escapement. The enclosing housing has a cutaway or opening that gives access to the barometric unit for adjustment, and a removable cap seats against the housing to seal and protect against the elements. When the barometric control unit is applied to the timer-actuator referred to and the timer-actuator is attached to a parachute or the like, the time for removal of the trip pin becomes less critical since the barometric control determines that the timer-actuator cannot be started above a certain altitude that has been earlier selected. As an example, the trip pin might be withdrawn by a static line when the person jumps, or when the load is ejected from the craft. Although the trip pin has been withdrawn the timer mechanism cannot start operating until the person or load has descended far enough to permit the change in air pressure to release the interposed lever.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a top plan view of my timer-actuator

2

fitted with my improved additional control device, the sealing cap being removed to show the means for setting to desired conditions of operation.

Fig. 2 is a longitudinal sectional view of Fig. 1 substantially as indicated by the line and arrows 2—2.

Fig. 3 is a plan view of the timer-actuator with the cover and additional control unit removed, parts being broken away to better illustrate the relation of certain parts, the view being taken along the line and in the direction of the arrows 3—3 of Fig. 2.

Fig. 4 is an enlarged elevational view of the additional control unit substantially as indicated by the arrow 4 in Fig. 2.

Fig. 5 is a sectional view on a large scale through the base of the additional control unit showing details of the pivot for the release arm, the view being somewhat as indicated by the line and arrows 5—5 of Fig. 4 and Fig. 7.

Fig. 6 is a transverse enlarged sectional view through the additional control and part of the instrument casing substantially as it would appear if taken along the line and in the direction of the arrows 6—6 in Fig. 7.

Fig. 7 is an enlarged view in plan of the supporting member for the barometric unit and showing the relation of the control cam and the release lever with respect to the trip pin and the escape mechanism.

Fig. 8 is an enlarged view in end elevation substantially as indicated by the arrow 8 in Fig. 7.

Fig. 9 is a sectional view through the top of the barometric unit and casing cap substantially as indicated by the line and arrows 9—9 of Fig. 6.

Referring to the drawings in detail, and first with respect to Figs. 1 to 3, the numeral 10 indicates a housing member in the form of a metal box having one open side to be closed by a plate 12 cooperating with the bottom of the housing to provide journals or bearings for the gearing of the timer-actuator. The gearing comprises a spring motor 14 made up of a shaft 16 secured to a spring enclosing drum 18 and a sleeve 20 relatively rotatable about the shaft 16 and within the plate 12. The shaft 16 is rotatable in a pocket or recess 22 of the housing. A spiral spring 24 is enclosed within the drum 18 and has its outer end secured thereto while its inner end is secured to the sleeve 20. The sleeve 20 extends through the plate 12 and ends in a tongue 26 whose end is beveled off at 28. The tongues 26 have driving engagement with a lock disc 30 while the bevels 28 ratchet over the end of a cable winding spool

32 rotatable on the extended end of the shaft 16. The lock disc 30 is notched to receive the lug end of a spring urged lock lever 34 pivoted in the housing members by a shaft 36. The spool 32 has its lower flange notched at 38 to be engaged by the hook end of a retaining lever 40 secured on a shaft or pivot 42. A tail lever 44 joining the lever 40 is disposed to engage a cam surface of a lever 46 journalled at 48 in the housing members. A lever 50 secured to the same shaft 48 has one end riding on the side of the spring drum and is adapted to drop into a slot 52 when the spring 24 is wound up as shown in Fig. 3. A spring 54 anchored to the lever 40 has a stressed arm 56 bearing against the lever 46 and tends to project the hook end of lever 40 into one of the notches 38 of the cable spool, when the end of the lever 50 is riding on the outside of the drum 18.

The upper end of the shaft 16 is squared off at 58 for reception of a winding key and rotatably supports a knob 60 secured to a plate 62 that has a depending stem 64 with a reduced portion like a pin 66 passing by the edge of the spool 32, the lock disc 30 and extending through an arcuate slot 68 and selectively engaged in any one of a row of holes 72 of a driving gear 74 within the housing members and rotatably disposed about the sleeve 20 between the spring drum 18 and the plate 12. A spring 76 disposed between a cover 78 and the plate 62 keeps the pin 66 in the hole selected and tends to maintain the driving relation between the sleeve 20 and the spool 32. The driving gear 74 has ratcheting engagement with the top of the spring drum 18 at 80, and engages a pinion 82 integral with a larger gear 84, meshing with a pinion 86 driving an escapement wheel 88 cooperating with an escapement lever 90. All of the gears 82, 84, 86, 88 and the lever 90 are mounted on shafts that have their end pintles journalled in the bottom of the housing 10 and the plate 12. The escapement lever 90 has a lug 92 for engagement with an abutment to restrain it from operation. Obviously, if the escapement lever is arrested, one of its pallets 94 will be held in engagement with the teeth of the escapement gear 88. In the timer-actuator above referred to, the arresting of the escapement lever is accomplished by a removable trip pin 96 engaging the lug 92 that was pulled away when it was desired to set the timer mechanism operating. In the improved control here disclosed, a member 98 is interposed between the pin 96 and lug 92. The member 98 is controlled by the barometric unit referred to as will presently be explained.

If the escapement lever is arrested, then the whole gear train is held against movement so that the spring motor 14 may be wound up. When unwound the spring 24 lays against the inside of the spring drum 18 and holds the lever 50 outward so that the shaft 48 is rotated clockwise to oscillate the cam lever 46 clockwise toward the lever 40 so that the hook end thereof is urged into one of the notches 38 of the spool 32. That prevents counterclockwise rotation of the spool 32. The cable 100 cannot be fully wound up. Prior to winding the spring 24 the selector knob 60 is actuated to set the pin 66 in one of the holes 72*a* or 72*b* of the driving gear 74. That selecting removes the depending portion 64 from engaging relation with the spring urged lock lever 34 so that its end can drop into a notch of the lock plate 30, which prevents the plate and attached sleeve 20 attached to the end of the spring from turning in a clockwise direction. Under those conditions rotating the shaft 16 by means of an appropriate key, rotates the spring drum 18 which ratchets over the provisions 80 and with respect to the driving gear 68 which is held against movement by the pin 96. When the spring is fully wound up, the outermost turn is retracted from the inside of the drum so that the lever 50 is urged through slot 52. That is by reason of the spring 54 which rocks the cam lever 46 that results in oscillating the lever 40 away from the spool notches 38. That permits the cable 100 to be pulled out and attached to the device to be actuated. Thus it is insured that the power developing means must be conditioned for operating the device before the actuating cable can be attached, a very important safety feature. The timer-actuator is now normally ready for operation when the release pin 96 is removed. However, the interposed member 98 is still in position to prevent start of the time measuring device.

The interposed member 98 is in the form of a lug on an oscillating lever 102 and controlled by the additional control unit 104 enclosed within the timer-actuator unit, and illustrated in Figs. 4 to 8 inclusive. The unit comprises a sub-base 106 adapted to mount against the top of the mounting plate 12 at one end of the instrument housing as shown in Fig. 2. The sub-base has a pair of spacing ribs 108 along each end and on top of which there is mounted a U-shaped bracket member 110 by rivets 112, having shims 114 and 116 disposed between the ribs 108 and bracket member 110. The shim 114 has a lateral flexible extension 118 that projects to one side of the associated rib 108 as shown in Fig. 7, where it is exposed through a key-hole shaped cut-out 120 which has a circular portion 122 and a peripherally joined rectangular portion 124. The extension 118 projects nearly across the opening 124 and provides an opening 126 disposed over an aligned aperture 128 in the sub-base 106. Those apertures 126 and 128 provide bearings for the conical points 130 and 132 respectively of a shaft 134 rigidly mounted in the oscillating lever 102, before referred to. The extension 118 is preflexed toward the sub-base 106 so that when the shaft 134 is mounted with the conical ends 130, 132 disposed in the apertures 126, 128, the lever 102 will be held firmly in its pivots or bearings without wobble or lost motion. The lever 102 when assembled in place has its lug 98 forming the before mentioned interposed member which extends through an aperture 136 to span the distance between the pin 96 and the lug 92 when the escapement lever 90 is locked against movement, as it is shown in Fig. 3. The plate 12 is similarly notched or apertured to coincide with the aperture 136 (though not shown) to permit oscillation of the lug 98 when the pin 96 is removed. The opposite end of the lever 102 is shaped to provide an arm 138 extending into the circular portion 122 of the cutout, and upwardly to a point above the plane of the bracket member 110 to end in a point or detent 140. Oscillation of the lever 102 is conditionally restrained by a web or cam flange 142 extending from a disc 144 carried by the movable wall 146 of an aneroid or barometric unit rotatably mounted on an inverted U-shaped bracket member 148 whose parallel flanges 150 telescope within the parallel flanges 152 of the bracket 110 to be rigidly united by rivets or the like 154, substantially as shown in Fig. 6. Rotatable in the center of the bracket 148 there is a plug 156 to which is anchored a sylphon or bellows head member 158, this head member being circular and substantially the same diameter as

the movable wall 146. A cylindrical bellows or flexible wall tubular element 160 has each end flange secured to the head member 148 and the movable wall 146 to enclose an expanding spring 162 under stress tending to separate the members 146 and 148. A tubular stem 164 extends through the disc 144 and the movable wall 146 by which the interior of the Sylphon is evacuated and sealed by closing at 166. All joints of parts making up the aneroid unit, such as the movable wall 146, the plug 156, the head member 158, the bellows 160 and the stem 164, are sealed by soldering or bonding to make the unit air tight.

The aneroid unit is supported by the top bracket 148 with the plug 156 capable of limited rotation in the bracket by reason of a radial key 168 on the periphery of the plug traversing a notch in the bracket adjacent the journal for the plug. A shim 170 surrounds the plug 156 and rests against the upper surface of the bracket 148, the shim 170 being bevelled at the outer edge to carry an index arrow 171 as shown in Fig. 1, and also having a notch engaged by the key 168 so that the shim will be rotated with the aneroid unit whenever the plug 156 is turned. To maintain the aneroid unit firmly in place so that the upper bracket 148 is against the top of the Sylphon head 158, a dished spring washer 172 is fitted over a reduced portion of the plug 156 and engages the shim 170 where it is held under stress by a spring ring 174 disposed in a peripheral groove about the reduced portion of the plug, such as is shown in Figs. 6 and 9. The Sylphon unit is thereby frictionally retained in any angular position with respect to the bracket 148 to which it is turned by the plug 156, a notch or screw-driver slot 176 being provided on the outer end of the plug to assist in that turning. A scale 178, calibrated in thousands of feet altitude, being marked on the upper surface of the bracket 148 adjacent the before mentioned arrow, assists in indicating the rotative position of the plug.

Rotation of the plug 156 also rotates the aneroid unit and cam flange 142 attached to it. When the additional control unit is properly assembled, the cam flange 142 will be disposed over the cut-out 122 of the lower bracket and will be suspended above the detent or point 140 of the lever 102. The cam flange 142 is arcuate and concentric about the axis of the plug 156 ending with an incline surface 180 cooperable with the detent 140 of said lever. Obviously, if the aneroid unit is rotated to different angular positions, there will be required different degrees of collapse of the capsule before the lever 102 can be oscillated without the point 140 being obstructed by the cam flange 142. The cam flange 142 and detent 140 are so related and associated that when the point or detent 140 is bearing against the inside of the cam flange 142 as shown in Fig. 7, then the interposed member 98 on the other end of the lever will be properly disposed to fill all the space between the release pin 96 and the lug 92 of the escapement lever. It therefore necessitates that the cam flange 142 be withdrawn from its obstructing position before the lever 102 can oscillate away from the lug 92.

The additional control unit 194 as shown in Figs. 4 and 6 is mounted against the plate 12 of the timer-actuator as shown in Fig. 2, there being holes 182 in the corners of the sub-base 106 that are aligned with similar holes 183 in the corners of the plate 12, and that are also aligned with threaded holes in corner bosses 184 of the housing member 10. Spacers 186 are disposed between the cover 78 and the sub-base 106 so that screws 188 when threaded into the corner bosses 184 will hold the cover and additional control unit firmly in place. A cable clamp 190 has a flange 192 apertured to receive the screws 188 and unites with a clip 194 to anchor a flexible conduit 196 which encloses and guides the release pin 96. A second cable clamp 198 at the other end of the cover 78 cooperates with a clip 200 to anchor a flexible conduit 202 enclosing the actuator cable 100 in a similar manner.

The cover 78 carries a number of headed pins 204 that cooperate with keyhole slots 206 in a cup-like member 208 used to enclose and seal over the setting knob 60 as described in the aforementioned application. The cover 78 is apertured at 210 with winged extensions 212 that is disposed directly over the plug 156 of the additional control unit. The aperture 210 gives access to the plug 156 for adjusting to the altitude at which the arm 102 will be permitted to release the timer mechanism, which altitude is indicated by the scale 178 on the top of the bracket member 148 and observable through one of the winged extensions 212. The portions of the cover 78 bounding the aperture 210 and between the winged extensions 212 are bent upward and inwardly as indicated at 214 to provide locking cams cooperating with a bar 216 secured inside of a cap 218 carrying a seal ring 220 engageable with the cover 78 as shown in Figs. 6 and 9. The caps 208 and 218 together with their respective seals protect the working mechanisms within the housing and cover from moisture and foreign matter that might interfere with the proper operation of that timer-actuator.

For mounting the timer-actuator, the housing 10 has tongue-like members 222 and 224 at opposite ends that engage beneath arched loops 226 and 228 provided by a mounting plate 230 where it is secured by a holding screw 232, the overall length of the housing 10 being so much less than the distance between the loops 226 and 228 that the tongue 224 may be inserted beneath the loop 228 and slid within it far enough for the end of the tongue 222 to move laterally past the near edge of the loop 226 and then slide beneath it before the tongue 224 is withdrawn from the loop. With both of the tongues beneath their respective loops, then the screw 232 may be threaded into place to secure the unit in the proper mounted position. The mounting plate 230 provides holes 234 in each corner that makes for the use of rivets, screws or bolts by which the unit may be secured to a package or the like, while the smaller holes 236 adapt the use of thread, string, wire or thongs by which the mounting plate may be laced or sewed in place to clothing or to a parachute harness, or to a cloth or fabric wrapper of a parcel.

To prepare the apparatus for use, assuming that it is coupled to the mounting plate that is installed for actuating a device by a pull or tug upon the cable 100, the first thing done is to insert the release or trip pin 96 which strikes the slanting surface of the lug 98 and biases it against the lug 92 of the escapement lever 90. The biasing of the lever 102 rocks it clockwise about the pivot 126 as viewed in Fig. 7, during which, the detent 140 rocks inward of the cam flange 142. After inserting the trip pin 96 and arresting operation of the escapement mechanism, the knob 60 is raised and turned slightly clockwise from the position adjacent the lock lever 84 which allows the lever to lock the disc

30 for holding the inner end of the spring substantially fixed. The cable 100 being wound upon the spool, the outermost leaf of the spring 24 will lay against the inside of the drum 18 so that the lever 50 rocks the cam lever 46 clockwise to bias the safety lever 40 into engagement with the notches 38 in the edge of the spool which prevents unwind of the cable 100 from the spool. Thus, the spring 24 must be rewound completely before the cable can be attached to the load, and before the device can be set for operation. Rotation of the shaft 16 in a clockwise direction as viewed in Fig. 3 restores driving power to the device, since the inner end of the spring 24 is held against movement by the lock lever 34, disc 30, and sleeve shaft 20, to which the inner end of the spring is fastened. The trip pin 96 being in place, the gear train of the escapement mechanism is held against movement while rotation of the shaft 16 drives the spring housing 18 and causes it to ratchet over the tongues at 80 which are held against movement by the release pin 96 holding the gear train inactive.

Complete winding of the spring 24 by rotation of the shaft 16 causes the outside turn of the spring to retract from the inside of the spring housing to uncover the opening 52. The lever 50 may now oscillate to a position extending within the housing 18 through the opening 52 substantially as shown in Fig. 3. The shaft 48 thereby rotates to oscillate the cam lever 46 counterclockwise, which rocks the lever 40 clockwise away from the spool flange 32 and therefore disengages the notches 38. The spool 32 is now capable of rotation for withdrawing the cable 100 which is done by pulling upward on the knob 60 to disengage the driving provisions 26 and permit the spool to ratchet over beveled portion 28. While the knob 60 is in this outward position it is, or may be, turned to spot the pin 68 in the proper one of the time designating holes 72 for which the actuator is to operate after escapement release by the trip pin 96.

By selected setting of the pin 68 in one or another of the time designating holes 72 the unit may be made to set off actuation of the cable 100 either substantially coincident with removal of the trip pin 96, or at the elapse of a definite period of time after removal of the trip pin. On the other hand, actuation of the cable 100 may be in accordance with other factors, such as the additional control by means of the aneroid unit. If operation is desired after that last mode of control, the cable will then be actuated substantially at the instant of release, not by the removal of the trip pin 96, but by the disengagement of the detent 140 and cam flange 142. Also, the actuation may be at the end of a measured interval of time after that disengagement. Obviously, if each of the holes 72 stand for a different time interval, and are spaced one or two seconds apart, then a setting of the pin 68 in the hole 72*a*, actuation of the cable 100 will be almost coincident with the start of the escapement mechanism, whether it be set into motion by the withdrawal of the trip pin 96 or by the disengagement of the detent and cam flange. Yet if the pin 68 is set in the hole 72*n* nearly diagonally opposite to 72*a* a much longer time will elapse before the cable is actuated, and effects a measured time interval of actuation after the start of the timing mechanism.

The altitude scale 178 graduated in thousands of feet means that the flange 142 will not disengage the detent 140 at an altitude greater than that for which the index is set. In Fig. 1 the index 171 is set at 15 meaning that the parts 140 and 142 will be in non-obstructing relation at altitudes less than 15,000 feet. If the pin 68 is set in hole 72*a* and the pin 96 removed while the unit is at an altitude below that for which the index 171 is set, then the cable 100 will be actuated almost coincident with the removal of the pin 96. If the pin 68 is set in hole 72*n* while othe other conditions remain the same, then the cable will be actuated at the end of about thirty seconds after the pin 96 is removed. Then consider that the pin 68 is in the time designating hole 72*a*, and that the release pin 96 is removed at an altitude greater than that indicated by the index 171. The cable 100 will be actuated under those conditions only after the timer-actuator unit has descended to the altitude indicated by the index 171. If the pin 68 is set in time designating hole 72*n* with the other conditions the same, then the cable will be actuated about thirty seconds after the timer-actuator unit has descended to the level indicated by the index 171.

Operation of the timer-actuator in any mode is the same, and when equipped with the additional control by the aneroid unit, gives such control over a load to which it is attached that person or parcel may be discharged from an aircraft at very high altitudes with the assurance that the load will reach the earth's surface in the best of condition. Let it be assumed that the aneroid unit is set with the index arrow 171 at 15,000 feet and that the timer knob 60 is set at thirty seconds, say in the time designating hole 72*n*, with the craft traveling at 25,000 feet altitude, when the load is discharged from the craft. It is very desirable, especially if the load is a person to which a parachute is attached that the load be removed from the rarefied atmosphere as soon as possible. Delay in opening the chute is therefore of necessity, and the load is permitted to free fall to a safe altitude before any release mechanism is put into operation. In discharge from the craft the trip pin 96 may be removed by static line or otherwise, but the escapement mechanism is still restrained from operation because of the member 98 engaging the lug 92. Under the low pressure experienced at the high altitude the aneroid unit 104 will have expanded to dispose the cam flange 142 in front of the detent 140 which prevents oscillation of the arm 102. As the load descends in the free fall it reaches the 15,000 foot altitude at which the aneroid unit is collapsed enough to permit the detent 140 to escape the edge of the cam flange 142, and which permits the member 98 to oscillate away from the lug 92. However, the cable 100 is not yet actuated. The escapement mechanism starts to operate and permits the driving gear 74 to rotate counterclockwise carrying with it the pin 68. During that movement the stem 64 supporting the pin 68 moves past the hooked end of the safety lever 40 and beyond the position for the time designating hole 72*a* to engage the lock arm 34 and cam it out of the notch of the lock disc 30. Immediately that the lock disc 30 is released the remaining energy in the spring 24 is suddenly expended in rotating the spool 32 clockwise as viewed in Fig. 3, which will actuate the cable 100 by winding it up on the spool.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A timer-actuator for effecting actuation of a selected device in response to the occurrence of preselected conditions in combination with a selected interval of time, comprising in combination, a spool provided with an actuator cable adapted to be attached to the device to be actuated, a spring power unit selectively operable to drive said spool, a gear train driven by the power unit, an escapement mechanism regulating the operation of the gear train, and having a stop lug, means including a release pin for arresting the operation of the escapement mechanism, means for selecting the interval of time in which the gear train will operate after the start of the escapement mechanism before the spool will be driven, and a conditions responsive unit having a member interposed between the stop lug of the escapement mechanism and the release pin to control the start of the escapement mechanism though the release pin has been withdrawn, whereby the selected device is actuated only when the selected time interval has elapsed after the occurrence of the preselected conditions.

2. A timer-actuator for effecting actuation of a selected device in response to the occurrence of preselected conditions in combination with a selected interval of time, comprising in combination, a spool with actuator cable for actuating the selected device, a spring motor for driving the spool in one direction in order to wind up the cable, a gear train with escapement mechanism driven in the opposite direction by said spring motor, means including a release pin and an interposed member for restraining the operation of said escapement mechanism, a lock lever engaging a part of the gear train for restraining the drive of said spool, selective time interval means actuated by the gear train for releasing said lock lever, a barometric unit for actuating said interposed member, and manually controlled means for determining the conditions under which the interposed member will release the escapement means, whereby the lock lever will be released at a predetermined interval after occurrence of the determined conditions.

3. A timer-actuator for effecting actuation of a selected device at the end of a selected interval of time after reaching a predetermined altitude in descent, comprising in combination, a cable winding spool for actuating said device, lock means for restraining said spool against winding movement, power means including an escapement for driving said spool, selective interval determining means for releasing the lock means so that the spool may be driven a predetermined interval after the escapement means is set into motion, and means controlling the start of the escapement means including a removable pin and an interposed member, a barometric unit for control of the interposed member, and means for setting the barometric unit to actuate the interposed member when a predetermined altitude of descent has been reached, removal of said pin failing to start the escapement means unless the descent has reached an altitude less than the predetermined altitude.

4. A timer actuator for aerial delivery, a spool and cable adapted to actuate a device, a power unit for driving the spool in response to the occurrence of preselected altitude and time interval conditions, an escapement means for restraining the operation of the power device, selective means for setting the interval of time the escapement means will restrain the power device before the spool is driven, means for controlling the start of the escapement means including a removable pin and an oscillating lug interposed between the pin and the escapement means, a pressure responsive bellows controlling the oscillation of said lug, and means for selecting the pressure condition under which the lug will be permitted to oscillate, said lug and pin when in engagement preventing the operation of said escapement and hence the drive of the cable spool.

5. The combination set forth in claim 4 wherein a casing encloses the spool and the pressure responsive bellows and provides a sight opening over the bellows for its setting, caps with seal ring removably secured over the interval setting means and the pressure selecting means to prevent foreign matter interfering with the operation of the timer actuator.

6. A timer actuator for aerial delivery, comprising in combinotion, a cable winding spool for actuating a selected device, releasable spool locking means for controlling the cable winding spool, a gear train with escapement means, adapted to release the spool lock, a spring motor operatively coupled between the spool and the gear train, an oscillatable lug engageable with the escapement means to restrain it against operation against the urge of the spring motor, a removable pin for holding the lug against movement, a barometric unit for control of the oscillatable lug when the pin is removed, whereby the escapement means is restrained against operation until a selected altitude of descent is reached, said spring motor then driving the escapement means for a preselected interval of time before releasing the spool lock, and after releasing the spool lock then driving the spool from the gear train as an abutment.

7. The combination set forth in claim 6 wherein a housing provides a mounting plate for enclosure of the spring motor and escapement means, and a cuplike cover encloses the spool locking means and barometric unit, while a single set of hold-down screws secure the housing, mounting plate, barometric unit and cuplike cover in proper assembled relation, and an aperture in said mounting plate through which the oscillatable lug extends to engage the escapement means.

8. The combination set forth in claim 6 wherein the barometric unit comprises a sub-assembly including an adjustable dial and cam flange cooperable with a lever providing the oscillatable lug, and mounting means for the unit disposing the oscillatable lug in interposed relation between the escapement means and the removable pin.

9. The combination set forth in claim 6 wherein the barometric unit comprises a pair of U-shaped brackets with their leg portions in telescoped relation, an exhausted capsule disposed between the brackets and having a central plug mounted for limited rotation in the bridge portion of one of the brackets, a cam flange carried by the capsule and rotatable with the central plug, a sub-base secured to the other of said brackets, a lever providing said oscillatable lug and having a detent engageable with said cam flange of the capsule, and conic pivot means for the lever eliminating lost motion in its oscillation between the cam flange and the escapement means.

10. In a timer-actuator for aerial delivery of loads, having a member to be operated in response to interaction of altitude and time interval measuring means, and a release pin for conditioning the timer-actuator to respond to the said inter-

action, the combination of a barometric unit having a part interengaging between the release pin and the time interval measuring means for altitude control of the said member, said unit comprising a sub-base, a rectangular framework mounted on the sub-base, an evacuated capsule disposed within the framework, a plug carried by the capsule and having a journal bearing in said framework, the free end of said capsule being disposed adjacent the sub-base and providing a cam flange, a lever supporting the interengaging part and having pivotal support between the sub-base and frame-work, said lever having a lateral extension engageable behind said cam flange for extreme altitudes, the rotation of said capsule plug in the framework determining the altitude

that the cam flange will release the lateral extension of the lever to withdraw the interengaging part from the path of the time interval measuring means.

11. The combination set forth in claim 10 wherein the pivotal support for the lever comprises a shaft ending in conic points, a leaf spring secured between the sub-base and framework, and aligned apertures provided by the leaf spring and sub-base receiving the conic points of the lever shaft, whereby all lost motion of the lever pivot is eliminated.

WILLIAM H. KUNTZ.

No references cited.