March 22, 1966 C. P. CAIRELLI 3,241,870

LATCHING MECHANISM

Filed April 4, 1963 2 Sheets-Sheet 1

Fig. 1

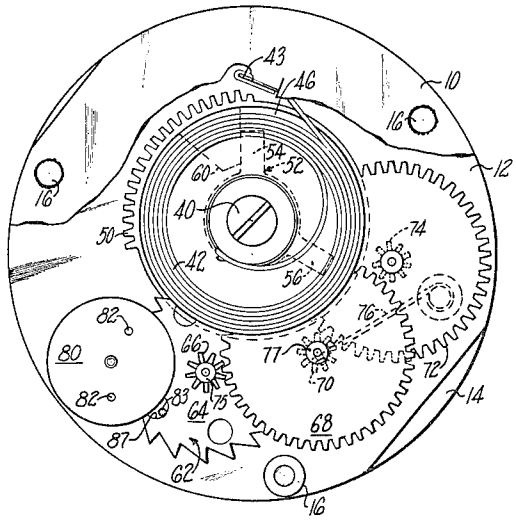
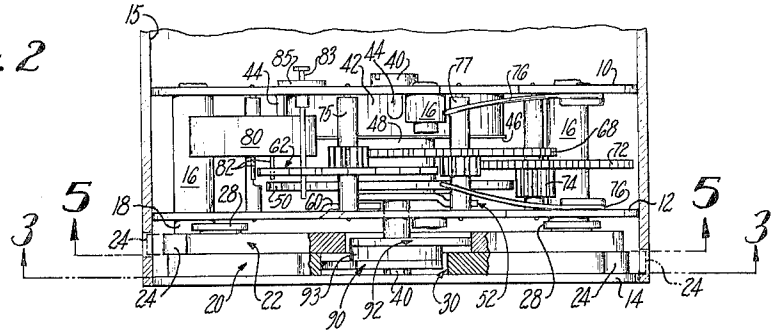


Fig. 2



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March 22, 1966 C. P. CAIRELLI 3,241,870

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Filed April 4, 1963 2 Sheets-Sheet 2

Fig. 3

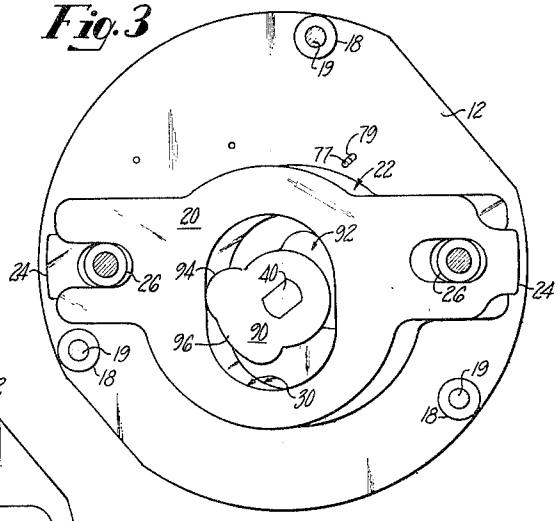


Fig. 4

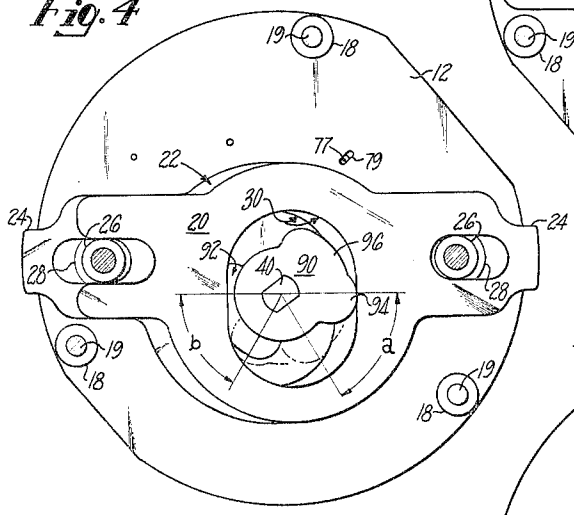


Fig. 5

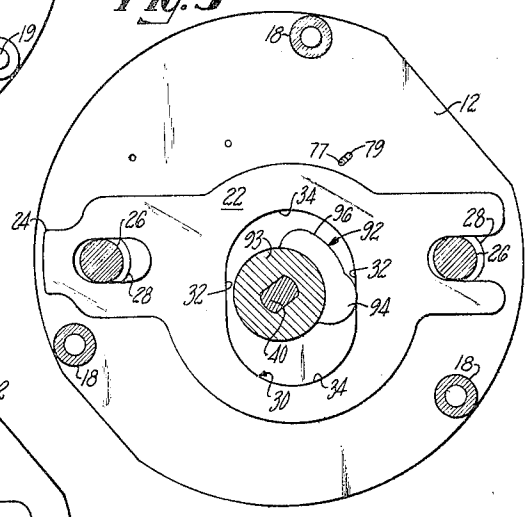
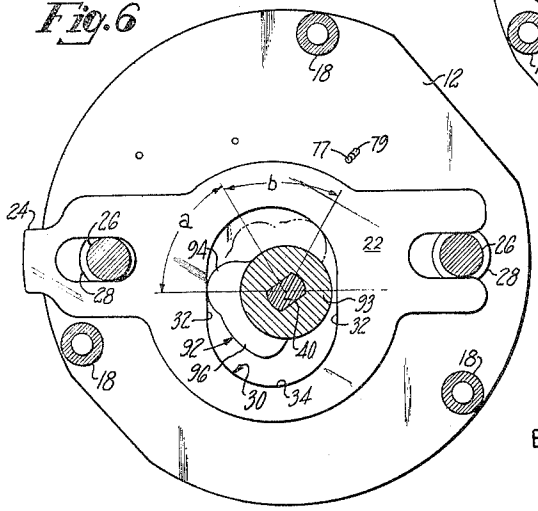


Fig. 6



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3,241,870

LATCHING MECHANISM

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7 Claims. (Cl. 292—144)

This invention relates to new and improved latching mechanisms and more particularly to a latching mechanism of the type actuated by the angular displacement of a rotary operator.

A principal aim of the present invention is to provide a new and improved latching mechanism of the type described adapted for automatic actuation after a preselected time interval. A significant use of the present invention is for the automatic unlatching after a preselected time interval of the enclosure cap of an aerospace vehicle sent aloft for the measurement of temperature, humidity or other phenomena, and from which enclosure scientific instruments are ejected for taking those measurements. Therefore, the principal aim of the present invention includes the provision of a latching mechanism reliable under high G loading and within abnormal temperature, moisture and humidity environments, which is compactly constructed for installation within the usual cylindrical enclosure of a rocket or other aerospace vehicle, and which is adapted for automatically unlatching an enclosure cap at a preselected and accurate time interval after the launching of the vehicle.

Another aim of the present invention is to provide a new and improved latching mechanism that can be conveniently actuated for providing highly reliable operation even though the forces, frictional or otherwise, restraining the movement of the latching parts be substantial.

A further aim of the present invention is to provide a new and improved latching mechanism of the type described having a pair of oppositely extending latching parts that are simultaneously operated by angular displacement of the rotary operator and with minimum loading and wear on the mechanical parts.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application of which will be indicated in the appended claims.

In the drawings:

FIG. 1 is a top plan view, partly broken away and partly in section, of a preferred embodiment of the latching mechanism of the present invention;

FIG. 2 is a side elevation view, partly broken away and partly in section, of the latching mechanism installed in a cylindrical casing, showing the latching mechanism in solid lines in the fully withdrawn position and a portion thereof in phantom lines in the fully extended position;

FIG. 3 is a section view taken along the line 3—3 of FIG. 2 of the latching mechanism in the fully withdrawn position;

FIG. 4 is a section view similar to FIG. 3 of the latching mechanism in the fully extended position, further showing a portion of the latching mechanism in phantom in two intermediate positions;

FIG. 5 is a section view taken along the line 5—5 of FIG. 2 of the latching mechanism in the fully withdrawn position; and

FIG. 6 is a section view similar ot FIG. 5 of the latching mechanism in the fully extended position, further showing a portion of the latching mechanism in phantom in two intermediate positions.

Referring now in more particularity to the drawings, a preferred embodiment of the latching mechanism of the present invention is rigidly constructed with a frame having three parallel mounting plates 10, 12 and 14 shown to be of generally circular shape for convenient installation within a tubular shell or casing 15. The end plate 14 provides a cap for the casing and upon removal allows for ejection, as by a loaded spring, of the contents within the casing. Such enables the casing to be used as a vehicle sent aloft with scientific instruments for measuring atmospheric phenomena as, for example, a conventional rocket-sonde vehicle sent aloft for measuring phenomena in the upper atmosphere.

Three transverse pillars 16 staked to the inner plate 10 provide for mounting the central plate 12, and three cylindrical spacers 18 provide for mounting the end plate 14. The spacers 18 have ends (not shown) of reduced diameter threaded into the pillars 16 for rigidly securing the plate 12, and screw fasteners 19 (shown in section in FIGS. 3 and 4) threaded into the outer ends of the spacers 18 provide for rigidly securing the end plate 14. Latching of the end plate 14 within the tubular housing 15 is provided by a pair of identical overlying latching catches or bolts, generally denoted by the numerals 20 and 22, stamped from sheet metal. The bolts have locking ends 24 projecting beyond the periphery of the end plate 14 when the bolts are extended, as shown in phantom in FIG. 2, for receipt within diametrically opposed slot openings in the tubular housing 15.

As seen in FIGS. 3 through 6, the bolts 20, 22 are radially slotted adjacent their ends for receiving a pair of inwardly extending studs 26 staked to the end plate 14. The studs 26 provide closely fitting guides for the radial movement of the bolts with the enlarged heads 28 of the studs retaining the bolts in their overlying relationship on the end plate 14. The bolts have enlarged central portions provided with race tracks shaped openings 30 defined in part by pairs of oppositely facing shoulders 32 extending perpendicularly to the axes of movement of the bolts and in part by pairs of oppositely facing generally semicircular, concave end shoulders 34 bridging the shoulders 32.

For driving the bolts an operating shaft or arbor 40 is rotatably mounted eccentrically on the plates 10 and 12 about an axis extending perpendicular to the planes of the flat locking bolts. The shaft 40 extends beyond the plate 12 and within the openings 30 midway between the end shoulders 34. A mainspring 42 having its inner end secured to the shaft and its outer end wrapped about a tang 43 inwardly extending from the plate 10 provides a torsional bias on the shaft in the counterclockwise direction (as seen in FIG. 1). The end of the shaft 40 opposite the bolts is shown slotted to provide for winding the mainspring in the clockwise direction as by a screwdriver. Inwardly turned tangs 44 of the plate 10 provides stops limiting the expansion of the mainspring, and a thin sheet metal plate 46 overlying the mainspring and positioned between it and an enlarged shoulder 48 of the shaft 40 prevents axial displacement of the mainspring.

Press-fit upon the shaft 40 between the plates 10 and 12 is a gear sector 50 and a stop 52 having two radially extending arms 54, 56 adapted for engagement with the edges of a pie-shaped tang 60 formed from the central plate 12. The projection 54 engages one edge of the tang 60, as seen in FIG. 1, to provide a forward stop for the angular movement of the operating shaft 40 and the projection 56 engages the opposite edge of the tang 60 to provide a reverse stop for the operating shaft, the angular freedom of movement of the shaft 40 being 180 degrees. The gear sector 50, on the other hand, is provided with teeth throughout an angle of substantially 100 degrees.

By a mechanism, including an escapement generally designated by the numeral **62**, somewhat similar to a clock mechanism, a portion of the forward angular movement of the shaft **40** is restrained for movement at a timed rate. The ratchet wheel **64** of the escapement is operatively connected to the shaft by pairs of meshing gears **66** and **68** and **70** and **72**, and by a gear **74** adapted for meshing with the gear sector **50**. As in a conventional clock mechanism, the ratchet wheel **64** and pinion **66** are fixed to a shaft **75** having reduced ends which are received for rotation within opposed openings in the plates **10** and **12**. In similar fashion, the gears **68**, **70** and **72**, **74** are rotatably mounted on the end plates; however, the openings **79** in the end plates for the shaft **77** supporting the gears **68**, **70** are elongated to provide for lateral movement of those gears outwardly from engagement with the mating gears **66**, **72**, respectively. A pair of music wire cantilever springs **76** are riveted to the inside faces of the plates **10**, **12** to place an inward bias on the shaft **77** for maintaining the gears **68**, **70** in engagement with their respective meshing gears.

A cylindrical pallet member **80** rotatably mounted on the end plates **10**, **12** similarly to the aforementioned gears, has axially extending pallet pins **82** adapted in the usual manner for controlling the rate of angular movement of the ratchet **64** and therefore of the shaft **40** when the gear sector **50** is in mesh with the gear **74**. The mass of the pallet member **80** and the drive ratio through the gears **66**, **68**, **70**, **72**, **74** and **50** determine the rate of angular movement of the shaft and can be selected as desired. In the shown embodiment, the gear sector **50** is positioned for meshing with the gear **74** during approximately the first 60 degrees of forward movement of the shaft **40** from its reverse stop, with the time of movement being approximately 30 seconds.

In operation, the shaft **40** is manually rotated in the reverse direction until the reverse stop **56** engages the tang **60**. Through the last 60 degrees of this reverse movement, the gear sector **50** meshes with the gear **74** to drive it and the gear **72** in the counterclockwise direction, as seen in FIG. 1. Because the ratchet **64** is restricted from movement in the reverse direction by the pins **82**, the counterclockwise movement of the gear **72** (as seen in FIG. 1) moves the gears **68**, **70** laterally outwardly to disconnect the gear train, and thereby allow for completion of the winding of the drive shaft. The mechanism may then be retained in the ready or wound position as by a control pin **83** inserted through a guide bushing **85** mounted on the plate **10** and through one of the angularly spaced openings **87** in the escapement ratchet.

Upon withdrawal of the control pin **83**, the escapement under the bias of the mainspring effects control of the angular movement of the shaft **40** during the first 60 degrees of forward angular movement of the shaft due to the engagement of the gear sector **50** with the pinion **74**. Upon termination of the engagement of the gear sector **50** with the pinion **74**, the drive shaft **40** is rotated forwardly at a relatively high rate by the force of the mainspring **42** through an angle of 120 degrees, an angle twice the angle of regulated or restrained motion.

For operatively connecting the bolts **20**, **22** with the drive shaft **40** there are mounted on the drive shaft within the openings **30** of the bolts **20**, **22** a pair of identical oppositely extending cams **90**, **92**, respectively. As seen in FIGS. 3 through 6, the end of the shaft **40** is machined to provide flats, and the cams **90**, **92** have corresponding slotted openings receiving the shaft to provide a drive connection therewith. A spacer **93** is located between the cams and the outer end of the shaft **40** is upset to rivet the cams to the shaft.

The fully wound or ready position of the drive shaft **40** is shown in FIGS. 4 and 6, with the bolts **20**, **22** in their extended locking positions. The cams **90**, **92** have diametrically opposed action lobes **94** of partially circular shape which engage the bolt shoulders **32** for maintaining the bolts in their extended locking positions and

so that the lines of contact between the lobes **94** and the shoulders **32** are in a plane with the shaft axis that is parallel to the axes of rectilinear movement of the bolts. Therefore, any forces which are directed inwardly through the bolts to the cams will not create a coupling moment on the drive shaft and, as they are in direct opposition, will function to counteract each other to reduce or eliminate the resultant force on the drive shaft. Similarly, with the drive shaft in the fully released or unwound position, as shown in FIGS. 3 and 5, with the bolts in their retracted positions, any forces directed through the cams and bolts are in direct opposition in a plane parallel to the axes of rectilinear movement of the bolts.

A retaining lobe **96** on the cams **90**, **92** has a partially circular cam edge coaxial with the shaft **40** with a radius slightly less than the radius of the apex of the cam edge of the action lobe **94**. Consequently, upon forward angular movement of the shaft **40** from the wound position shown in FIGS. 4 and 6, after the action lobe **94** moves out of engagement with the shoulder **32**, the retaining lobe **96** is normally out of contact with the shoulder **32** but, nevertheless, provides for preventing substantial inward movement of the bolts to retain them in locking engagement with the casing **15**.

In operation, the shaft **40** as aforementioned, will move an angle *a* of substantially 60 degrees under the control of the escapement, at which point the action lobes **94** have moved out of engagement with the shoulders **32**, as seen in phantom in FIGS. 4 and 6. At that point the shaft **40** moves rapidly under the torque applied by the mainspring, first an angle *b* of substantially 60 degrees prior to reengagement of the action lobes with the bolts as further seen in phantom in FIGS. 4 and 6. During this interval the retaining lobes **96** ensure that the bolts are sufficiently extended to lock the end plate or cap **14** to the casing.

The bolts **20**, **22** are withdrawn during substantially the last 60 degrees of forward movement of the shaft, with initial contact by the action lobes **94** with the bolts being in sliding engagement along the concave shoulders **34** for providing gradual acceleration of the bolts and thereby minimize the wear and shock on the moving parts. With the completion of the forward movement of the shaft, as seen in FIGS. 3 and 5, the action lobes **94** have fully retracted the bolts to release the latch.

It can therefore be seen that the latching mechanism of the present invention provides for automatic actuation of the sliding bolts after a preselected time interval, and is readily adapted for automatic unlatching of the cap of an aerospace vehicle. Additionally because of the new and novel relationship of parts, the operation of the latching mechanism of the present invention provides highly reliable operation with a compact assembly of parts related for minimum wear and shock.

As will be apparent to persons skilled in the art, various modifications and adaptations of the structure above described will become readily apparent without departing from the spirit and scope of the invention, the scope of which is defined in the appended claims.

I claim:

1. A latching mechanism comprising a pair of overlying elongated flat bolt members mounted in slidable engagement for longitudinal parallel rectilinear movement, said bolt members having overlying slot openings defined in part by pairs of opposed longitudinally spaced straight edges respectively, extending substantially normal to the axes of rectilinear movement of the bolt members and longitudinally extending opposed concave edges at least at one lateral end thereof, an operating shaft mounted for forward and reverse rotatable movement about an axis extending substantially normal to the flat bolt members and substantially normal to their axes of rectilinear movement, stop means for limiting the angular movement of the operating shaft in the reverse angular direction, and cam means on the operating shaft including a pair of

diametrically opposed convex action cam parts engageable with the opposed concave edges and with the pairs of opposed straight edges for extending the bolt members in opposite rectilinear directions upon reverse angular displacement of the operating shaft to its reverse limit and for withdrawing the bolt members inwardly upon forward angular displacement of the operating shaft from its reverse limit, said convex action cam parts with the operating shaft at its reverse limit engaging the straight edges of the bolt members along a line through the axis of the operating shaft parallel to the axes of rectilinear movement of the bolt members.

2. A latching mechanism comprising a pair of elongated bolt members slidably mounted for longitudinal parallel rectilinear movement, a latch operator mounted for rotatable movement about an axis extending substantially normal to the axes of movement of the bolt members, cam means on the latch operator providing a pair of convex camming parts, said bolt members having pairs of longitudinally spaced opposed straight follower edges extending normal to their axes of movement and engageable by the convex camming parts respectively to extend and withdraw the bolt members, said convex camming parts being diametrically related for engagement with opposed straight edges on the bolt members for simultaneous withdrawal and extension of the bolt members, forward and reverse limit means for restricting the angular freedom of movement of the latch operator in forward and reverse angular directions, means providing a torsional bias on the latch operator for moving the latch operator from its reverse limit position to its forward limit position, and means for restraining the rate of angular movement of the latch operator by the torsion bias during a first angle portion only of its forward angular displacement from its reverse limit position, said convex camming parts being oriented to engage the opposed straight edges of the bolt members to withdraw the bolt members during the forward angular displacement of the latch operator and after a forward angular displacement of the latch operator from its reverse limit position which is greater than said first angle portion whereby the latch operator may be accelerated by the torsional bias to provide snap withdrawal of the bolt members.

3. The latching mechanism of claim 1 wherein the means restraining the rate of angular movement of the latch operator comprises an escapement, and a rotatable gear and gear sector in mesh during the angle of restrained movement.

4. The latching mechanism of claim 1 wherein the restrained angle of movement is no greater than one-half of said angular freedom of movement.

5. A mechanism for latching a cap to an open ended housing comprising a pair of overlying bolt members slidably mounted on the cap for parallel rectilinear movement into latching engagement with the housing, said bolt members having overlying slot openings defined in part by pairs of opposed straight edges respectively extending substantially normal to the axes of movement of the bolt members, a latch operator mounted for rotatable movement about an axis extending normal to the axes of movement of the bolt members between reverse and forward limit positions, cam means on the latch operator including a pair of first diametrically opposed convex camming parts within the slot openings of the bolt members engageable with the pairs of opposed straight edges respectively for operating the bolt members in opposite rectilinear directions, said first convex camming parts with the latch

operator in its reverse limit position being engageable with opposed edges of the bolt members respectively along a line through the axis of the operator which is parallel to the axes of rectilinear movement of the bolt members, a generally helical mainspring operatively connected to the latch operator providing a forward torsional bias thereon, escapement means for restraining the rate of forward angular movement of the latch operator, and disengageable gear means including a gear sector on the latch operator providing for disconnecting the escapement means from the latch operator at a predetermined angle of the latch operator from its reverse limit, said gear sector being oriented on the latch operator so that the opposed convex camming parts are at positions intermediate the pairs of opposed edges respectively with the latch operator at said predetermined angle.

6. The mechanism of claim 5 wherein the cam means further includes a second pair of diametrically opposed convex camming parts angularly spaced from said first diametrically opposed camming parts and having a maximum radius less than the maximum radius of the first diametrically opposed camming parts.

7. A mechanism for latching a cap to an open ended housing comprising a pair of overlying bolt members slidably mounted on the cap for parallel rectilinear movement into latching engagement with the housing, said bolt members having overlying slot openings defined in part by pairs of opposed edges extending substantially normal to the axes of movement of the bolt members, a latch operator mounted for rotatable movement about an axis extending normal to the axes of movement of the bolt members, cam means on the latch operator including a pair of diametrically opposed camming parts within the slot openings of the bolt members engageable with the opposed edges for operating the bolt members in opposite directions, a generally helical mainspring operatively connected to the latch operator providing a forward torsional bias thereon, escapement means for restraining the rate of forward angular movement of the latch operator, and disengageable gear means including a gear sector on the latch operator operatively connecting the escapement means with the latch operator, said cam means and gear sector being angularly oriented on the latch operator so that the opposed camming parts are out of engagement with the opposed edges upon disengagement of said gear means, and forward and reverse stop means limiting angular movement of the latch operator to 180 degrees, said stop means being located so that, with the latch operator at its full forward and reverse positions, the said opposed camming parts engage the opposed edges along a line through the axis of the latch operator parallel to the axes of movement of the bolt members.

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