# United States Patent [19]

**Webb**

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[54] **PRESSURE OPERATED INDEXING MECHANISM**


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[52] **U.S. Cl.** ..... **74/128,** 92/65

[51] **Int. Cl.** ..... **F16h 27/02**

[58] **Field of Search** .... 74/128, 129, 130, 142; 92/6, 92/65



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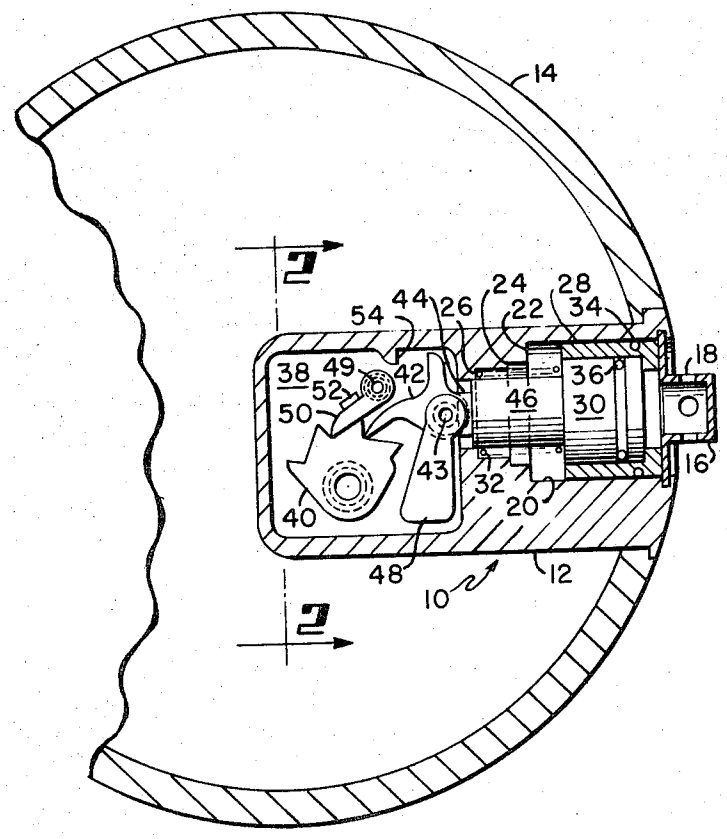
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[57] **ABSTRACT**

A pressure operated indexing mechanism to provide remote indexing of a mechanism through the use of fluid pressure pulses is disclosed. The device provides a means where a munition or other device can be indexed or set while in a closed container. A pair of telescoping pistons are acted on by externally applied pressure. The primary piston will advance the mechanism one position for each pulse of a predetermined pressure. Pressures higher than another and greater predetermined pressure will cause the secondary piston to cause the mechanism to reset to the start or safe position.


**8 Claims, 4 Drawing Figures**



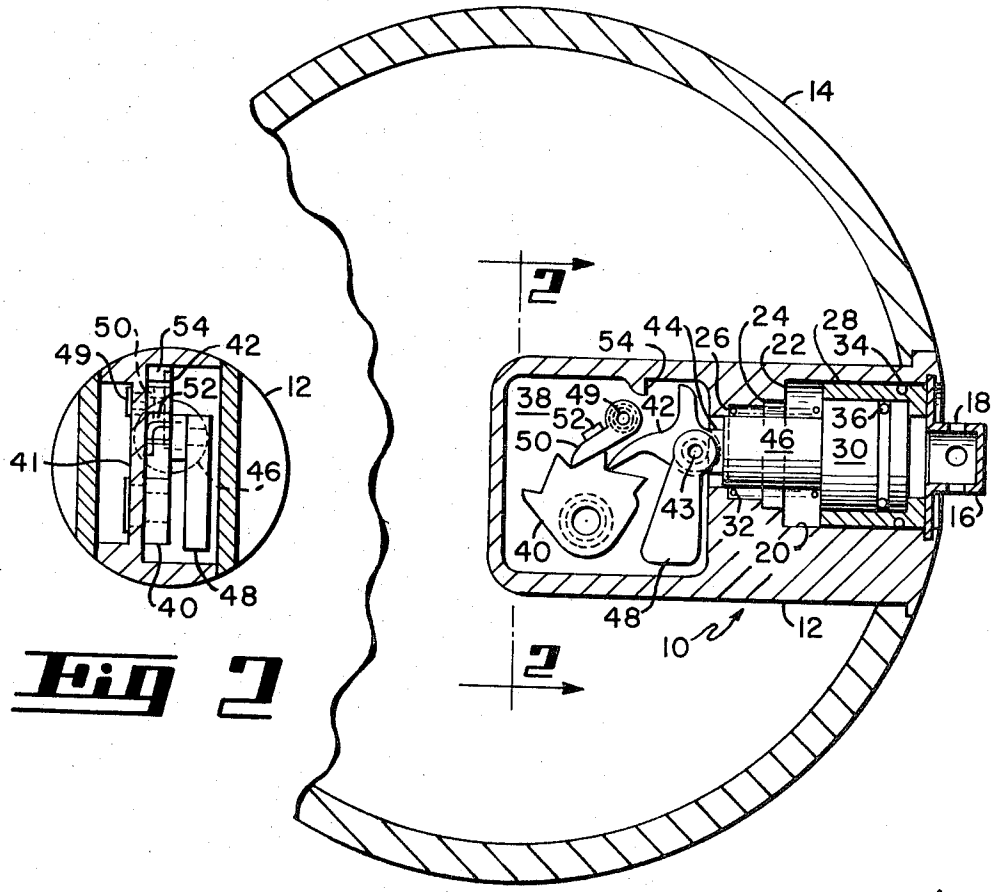



Fig 1




Fig 2

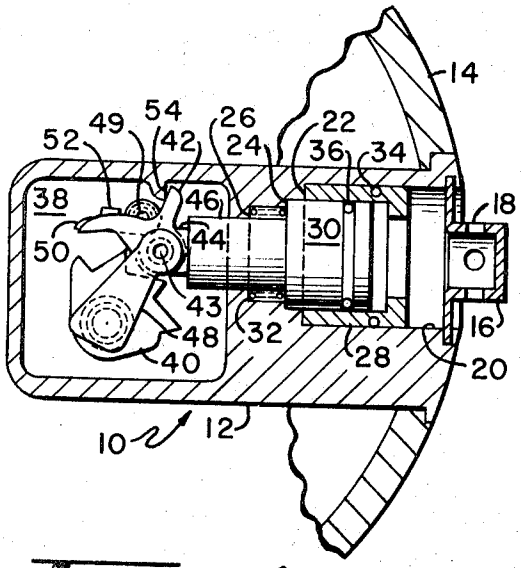



Fig 4

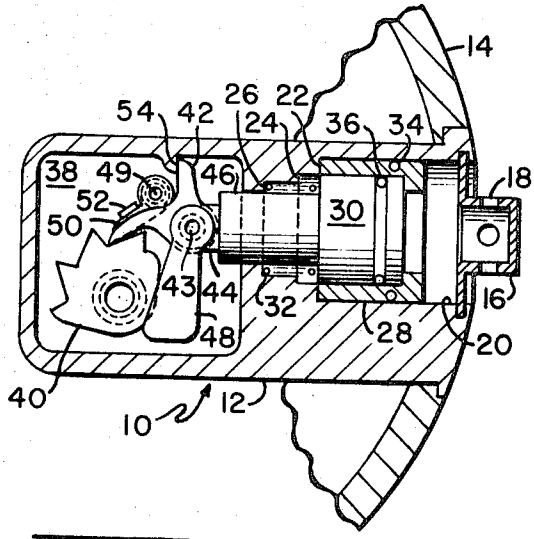



Fig 3

# PRESSURE OPERATED INDEXING MECHANISM

## SUMMARY OF THE INVENTION

This invention relates to indexing mechanism and more particularly to a fluid pressure operated indexing mechanism.

This invention provides for a pressure operated indexing mechanism of a simple and economical construction yet has a high functional reliability and one that is fail-safe under adverse conditions. The indexing mechanism is mounted within a housing which is secured in a container or munition. A dual piston assembly is responsive to fluid pressure pulses of a predetermined level to index a ratchet one position for each pulse of the predetermined level. Pressure pulses greater than a second preset level will cause the piston assembly to disengage a ratchet indexer to permit the ratchet to be reset to the start or safe position. Lock means are provided to hold the ratchet indexer at each position, the lock means being disengaged when pressure pulses above the predetermined level are present.

Other details, uses, and advantages of this invention will become apparent as the following description of an exemplary embodiment thereof presented in the accompanying drawings proceeds.

## BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings show a present exemplary embodiment of this invention in which:

FIG. 1 is a sectional view showing the pressure operated indexing mechanism of this invention in the safe or nonpressurized condition;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a fragmentary view similar to FIG. 1 showing the mechanism in the indexing condition after receipt of a pressure pulse of the predetermined level; and

FIG. 4 is a sectional view of the mechanism in the reset condition after receipt of the pressure pulse above the second predetermined level.

## DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Reference is now made to FIGS. 1 and 2 of the drawings which illustrate one exemplary embodiment of the pressure operated indexing mechanism of this invention, which is designated generally by the reference numeral **10**. The indexing mechanism **10** is secured in a housing **12** which is mounted in a munition or the like **14**. The indexing mechanism **10** is sealed within the munition **14** and only has communication with the outside environment through a suitable closure member **16** having a plurality of apertures **18** therein.

The housing **12** is formed with a stepped bore **20** therethrough, the bore **20** being provided with shoulders **22, 24** and **26**. A primary piston **28** is mounted for sliding movement within the large diameter portion of the bore **20**. The axial movement of the piston **28** is limited at one end by the closure **16** and the other end by shoulder **22**. A secondary piston **30** is mounted for sliding movement within the primary piston **28**. The diameter of the secondary piston **30** is such that it will clear the shoulder **22** but will engage shoulder **24**. A spring **32** is mounted in the bore **20** and acts at one end against shoulder **26** and at the other end against the secondary piston **30** so as to bias the primary and secondary pistons **28** and **30** to be in the safe position or nonpressurized position. Suitable O-ring seals or the like **34** and **36**, respectively, provide fluid seals between piston **28** and housing **12** and pistons **30** and **28**. The bore **20** is in communication with an enlarged chamber **38** in the housing **12** in which a ratchet **40** is mounted. The ratchet **40** is pivotally mounted to a wall **41** (FIG. 2). The ratchet **40** is connected with a switch, timer or such (not shown) in any conventional manner so that the switch, timer or the like is incrementally advanced from an initial safe position to an armed position as the ratchet is incrementally driven in a manner to be described hereinbelow. A torque spring (not shown) tends to return the ratchet **40** to the initial start or safe position.

The ratchet **40** is driven by a drive pawl **42** which is pivotally connected by pin **43** to a shaft extension **44** of shaft **46**. The shaft **46** is connected with the secondary piston **30** and is axially moved as the piston **30** is moved. A pendulous mass **48** is staked to the pin **43** and, hence, is fixedly connected with drive pawl **42**. A suitable torque spring (not shown) is associated with the drive pawl **42** to bias the drive pawl **42** into continuous engagement with the ratchet **40**. A lock pawl **50** is pivotally mounted by shaft **49** to wall **41** and is so mounted to engage the ratchet **40** to prevent rotation in the clockwise direction (FIG. 1) of ratchet **40**. Suitable torque spring (not shown) holds the lock pawl **50** into engagement with the ratchet **40**. As seen in FIG. **2**, the lock pawl **50** and drive pawl **42** move in parallel planes. The lock pawl **50** is formed with a transverse tab **52** which is engageable by the drive pawl **42**. Axial movement of the drive pawl **42** is limited by a stop **54** formed on the interior of the housing **12**.

In operation, the mechanism **10** may be preselected to index at a given pressure and to reset at a higher pressure. For purposes of explanation, it can be assumed that the mechanism will index at 15 psi and will reset at 30 psi. Thus, when a pressure pulse of 15 psi is applied to the munition **14**, the pressure pulse will be transmitted through apertures **18** of the closure **16** to act on the pistons **28** and **30**. A pressure of 15 psi will urge the primary piston **28** along the bore **20** until stopped by the shoulder **22**. The movement of the primary piston **30** axially along the bore thereby urging the drive pawl **42** to the left. Movement of the drive pawl **42** to the left causes the ratchet **40** to be rotated in a counterclockwise direction as viewed in FIG. **1** thereby causing the lock pawl **50** to ride up one tooth of the ratchet. At the point where the shoulder **22** stops the primary piston **28**, the lock pawl **50** drops over the ratchet to the position shown in FIG. **3** wherein the ratchet **40** has been indexed one increment. When the pressure is relieved from the piston **28**, the spring **32** returns the pistons to the start of the stroke and the lock pawl **50** holds the ratchet **40** in the new or pulsed position.

If it is desired to reset or resafe the switch or the like, a pressure pulse of 30 psi is applied to the indexing mechanism **10**. At the application of the higher pressure, the secondary piston **30** in spite of its smaller area overcomes the restraining force of the spring **32** and is urged axially along the bore **20** until stopped by the shoulder **24**. It is seen in FIG. **3** that the drive pawl **42** engages the stop **54** at the end of the 15 psi stroke. At

the application of the 30 psi to the secondary piston **30**, the drive pawl **42** is urged to the left causing the drive pawl **42** to be rotated clockwise about shaft **43** due to the contact between the stop **54** and the drive pawl **42**. The clockwise rotation of the drive pawl **42** causes the drive pawl **42** to engage the tab **52** (FIG. 4) thereby causing a like rotation of the lock pawl **50**. With the drive pawl **42** and lock pawl **50** disengaged from the ratchet **40**, a torque spring (not shown) returns the ratchet **40** and switch, timer or such (not shown) to the start or safe position. When the 30 psi pressure is relieved, the spring **32** again urges the pistons **28** and **30** back to the start of the stroke.

It is desirable that the area of the primary and secondary pistons **28** and **30** may be the same. In this way, the one spring may be used to sense both pressures since the force exerted on the primary piston then is twice that exerted on the secondary piston. This approach gives a high degree of reliability since the secondary piston can move its full displacement to provide the reset function when the primary piston fails to move in the housing. This enhances safety since failure to set at low pressure does not cause failure of the secondary piston, i.e., the reset function.

The use of the pendulous mass **48** provides a further fail safe operation in the presence of high inertial loads. In the analysis of a typical mechanism, approximately 300 G's are required to start the motion of the pistons. In other words, an inertial load of approximately 300 G's will give a simulated pressure of 15 psi which will cause the piston to move along the bore. However, the pendulous mass **48** is also acted upon by the G force and will tend to be rotated in a clockwise direction about the shaft **43**. The mass **48** will begin its rotational movement due to the inertial load at a load below the 300 G (simulated 15 psi). The rotation of the pendulous mass **48** overcomes the drive pawl spring (not shown) to uncouple the drive pawl **42** from the ratchet **40** before the shock load of this magnitude can cause the ratchet to be indexed. Should the shock load be very high, such as over 700 G's, the ratchet **40** will be reset as both the drive pawl **42** and lock pawl **50** will be disengaged from the ratchet due to the rotational movement of the pendulous mass **48**. This fail-safe operation is assured by the pendulous mass **48** on the drive pawl **42** and the housing stop **54** that forces rotation of the drive pawl **42** and lock pawl **50** in unison, as discussed previously.

It can be seen that the pressure operated indexing mechanism may be utilized in numerous ways. The indexing mechanism can be used in any fluid environment that can be pressure pulsed at one (index) or two levels (index and reset). The number of index points is a design consideration and depends on the particular use for which the indexing mechanism is used. Thus, it is seen that this invention provides a simple and economical device and provides for a reliable function that is fail-safe under adverse conditions. At a given pressure, the mechanism will index one position for each pulse of the given pressure. The mechanism will reset to the start or safe position in the presence of a pressure higher than the indexing pressure. In addition, the mechanism has fail-safe features that cause reset or saf-ing under high shock loads.

While a present exemplary embodiment of this invention has been illustrated and described, it will be recognized that this invention may be otherwise variously embodied and practiced by those skilled in the art.

What is claimed is:

**1.** A fluid pressure operated indexing mechanism for progressive indexing a given pressure and resetting at a higher pressure comprising:

a housing having a bore therethrough, said bore communicating with a chamber defined by said housing;

a ratchet pivotally mounted in the chamber, said ratchet being normally biased to an initial position;

a drive pawl for cooperative engagement with said ratchet;

a lock pawl mounted on said housing for cooperative engagement with said ratchet;

first and second concentric pressure responsive pistons mounted for slidable movement in said bore, said pistons being jointly responsive to the given indexing pressure, said drive pawl being pivotally connected with said second piston wherein axial movement of said first and second pistons along said bore in response to the given pressure will cause said drive pawl to engage said ratchet whereby said ratchet will be incrementally indexed in response to the given pressure and retained in the indexed position by said lock pawl, said second pressure responsive piston being mounted for slidable movement in a bore in said first piston and being responsive to a higher pressure than said given pressure thereby causing said lock pawl and said drive pawl to disengage said ratchet and permit said ratchet to be biased to its initial position; and

means for moving said first and second pistons in said bore to an initial position in the absence of pressure being applied to said pistons.

**2.** An indexing mechanism as set forth in claim **1** further comprising inertial safety means responsive to high inertial loads which simulate sufficient pressure to cause movement of said first and second pistons in said bore to disengage said drive pawl from said ratchet whereby incremental indexing of said ratchet is prevented due to movement of said first and second pistons in the bore due to the high inertial loads.

**3.** An indexing mechanism as set forth in claim **1** further comprising:

first and second shoulders in the bore for respectively engaging said first and second piston to limit the axial movement of each of said pistons wherein the given pressure acting on said first and second pistons will cause said pistons to move in the bore until stopped by said first shoulder whereby said ratchet is indexed one increment due to the movement of said pistons and wherein pressure at the higher pressure applied to said pistons will move said second piston along said bore to said second shoulder, said secondary piston movement causing continued axial movement of said drive pawl; and

further comprising means for imparting a rotational movement to said drive pawl in response to said continued movement of said second piston wherein said drive pawl is disengaged from said ratchet thereby preventing indexing of said ratchet due to the continued movement of said second piston.

4. An indexing mechanism as set forth in claim 3 in which said lock means is a lock pawl engageable with said ratchet, said lock pawl and said drive pawl moving in parallel planes, said lock pawl having a transverse tab formed thereon wherein said drive pawl engages said transverse tab during rotational movement of said drive pawl wherein said lock pawl is disengaged from said ratchet in unison with said drive pawl in response to movement of said second piston whereby said ratchet can return to the initial position.

5. An indexing mechanism as set forth in claim 4 further comprising inertial safety means responsive to high inertial loads which simulate sufficient pressure to cause movement of said first and second pistons in said bore to disengage said drive pawl from said ratchet whereby incremental indexing of said ratchet is prevented due to movement of said first and second pistons in the bore due to the high inertial loads.

6. An indexing mechanism as set forth in claim 5 in which said inertial safety means is a pendulous mass connected with said drive pawl wherein inertial loads imparted to the mechanism will cause said mass to have a rotational movement thereby rotationally moving said drive pawl to uncouple said drive pawl from said ratchet thereby preventing indexing of said ratchet in response to inertial loads.

7. An indexing mechanism as set forth in claim 6 further comprising a closure member mounted in said bore, said closure member being provided with a plurality of apertures wherein pressure applied externally of said closure member is transmitted to said pistons in the bore.

8. An indexing mechanism as set forth in claim 7 in which the area of said first and second piston is the same and in which said means for moving said pistons is a spring mounted in the bore and acting against said second piston.

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