

June 5, 1945.

C. SWIFT

2,377,461

TIMER

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Fig. 1.

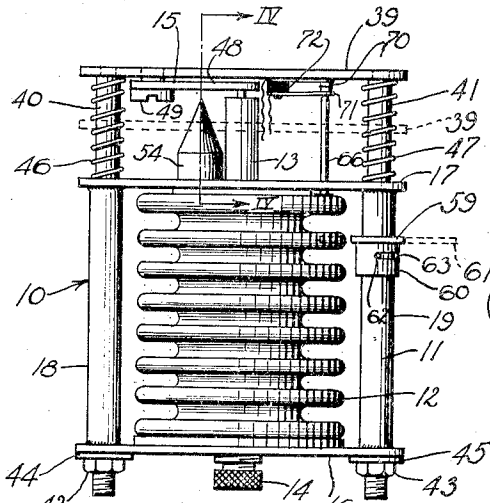


Fig. 3.

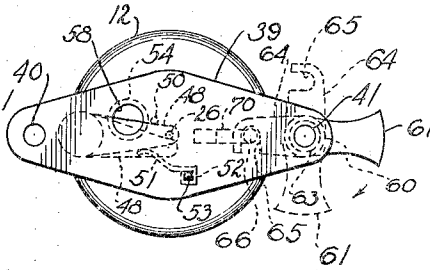


Fig. 2.

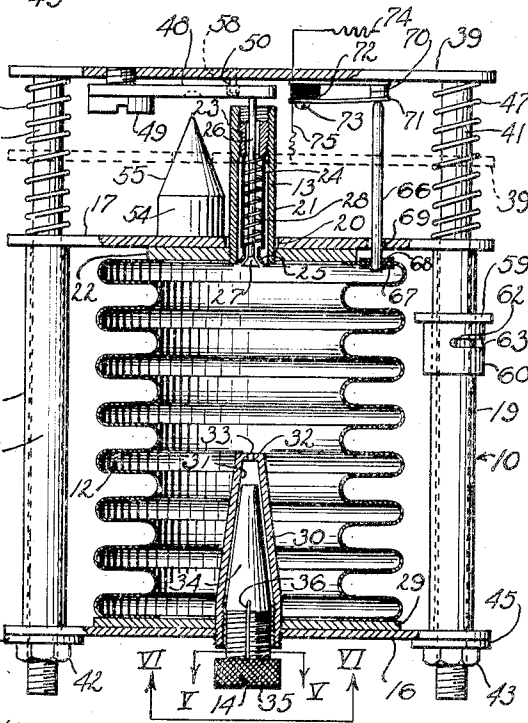


Fig. 4.

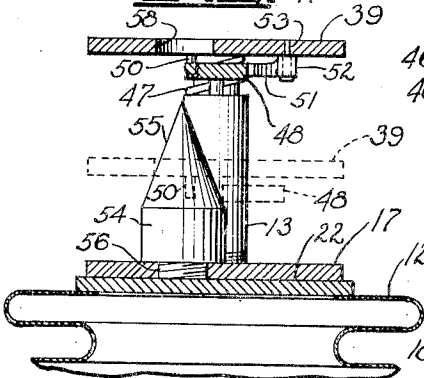


Fig. 7.

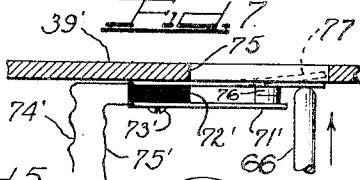


Fig. 5.

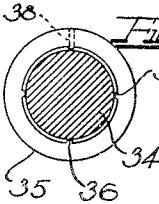
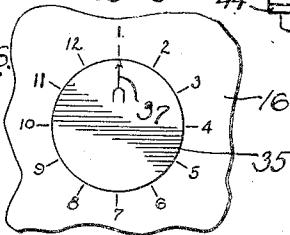


Fig. 6.



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UNITED STATES PATENT OFFICE

2,377,461

TIMER

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Application December 20, 1941, Serial No. 423,760

10 Claims. (Cl. 161-1)

The present invention relates to a timer device and more particularly to an adjustable device operable after a predetermined time interval to effect the starting or stopping of an associated mechanism.

Generally speaking, the timing device of this invention includes a bellows having a valve through which air is vented when the bellows is collapsed. The bellows has an air inlet sized for admitting air into the bellows at a predetermined rate. When the bellows is collapsed and air expelled therefrom, the rate at which air enters through the inlet as the bellows expands and when the vent valve is closed determines the time limit for the bellows to assume its normal expanded shape.

When the bellows nears its fully expanded shape, an actuating device thereon opens the vent valve and effects a snap action control for the starting or stopping of an associated mechanism either by the closing or opening of an electrical circuit or by the actuation of a mechanical linkage.

It has been found that the usual timing devices employed at the present time of the clock or gear mechanism type are not entirely satisfactory as their accuracy is affected when subjected to changes in temperature and atmospheric pressure, vibration, shock or other disturbances.

An object of the present invention, therefore, is to provide a simple timing device whose accuracy is unaffected when exposed or subjected to external disturbances.

Another object of this invention is to provide an accurate timing device adjustably operable by controlling the flow of air.

A further object of this invention is to provide a timing device which includes a snap action control for the starting and stopping of an associated mechanism.

Another and still further object of this invention is to provide a timing device having a bellows arrangement from which air is evacuated when the bellows is collapsed and including an air inlet sized to effect an exact time interval for expansion of the bellows arrangement.

A still further object of this invention is to provide a timing device with an expansion bellows arrangement having an air inlet sized for controlling the time interval required for the bellows arrangement to expand and also having a cam mechanism operated by the expanding bellows arrangement which effects a snap action control

for the starting and stopping of an associated mechanism.

A further object of this invention is the provision in a timing device of an expansible bellows having different sized air inlets operable at different stages of the expansion thereof for controlling the time interval for expansion.

Another and further object of this invention is the provision in a timing device of an expansible bellows having one air inlet sized for controlling an even rate of expansion of the bellows and another air inlet sized and operable near the end of the expansion for suddenly increasing the rate of expansion to a snap action.

A still further object of this invention is the provision in a timing device of a cam mechanism and an expansible bellows having a vent valve and an air inlet for controlling the time interval for expansion of the bellows with the cam mechanism being operable for controlling the opening and closing of the vent valve at predetermined positions of the bellows.

A further object of this invention is the provision of a timing device having an expansible bellows with a vent valve and an air inlet for controlling the time interval for expansion of the bellows and also having a cam mechanism operable for compressing the bellows and for controlling the opening and closing of the vent valve at predetermined collapsed and expanding positions of the bellows.

The novel features believed to be characteristic of the present invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and manner of construction, together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing, in which:

Figure 1 is a side view in elevation of a timer device constructed in accordance with the principles of the present invention;

Figure 2 is an enlarged view similar to Figure 1, with portions broken away, illustrating details of construction of the timer device of this invention;

Figure 3 is a top plan view of the timer device illustrated in Figure 1;

Figure 4 is an enlarged fragmentary vertical cross-sectional view as seen in the plane taken substantially along the line IV—IV of Figure 1;

Figure 5 is an enlarged transverse cross-sectional view as seen in the plane taken substantially along the line V—V of Figure 2;

Figure 6 is an enlarged fragmentary bottom view in elevation as seen in the plane taken substantially along the line VI—VI of Figure 2; and

Figure 7 is an enlarged fragmentary vertical cross-sectional view illustrating a modified form of construction in which an expanded bellows separates electrical contacts to open a circuit rather than to connect electrical contacts for closing a circuit as shown in Figures 1 and 2.

As best shown in Figures 1 and 2, the timing device 10 of the present invention generally includes a frame 11, an expansible bellows construction 12 having a vent valve 13 and an air inlet 14, and a cam mechanism 15 by which the vent valve 13 is automatically opened and closed during operation of the device.

The frame 11 includes the end plates 16 and 17 each shaped as shown in Figure 3 and which are connected together in spaced relation by vertical tubular supports 18 and 19. Connection between the tubular supports and the end plates may be by means of welding, brazing, soldering, threading or the like.

A cylindrical bellows 12 has one end thereof seated on the end or base plate 16 and connected thereto in any suitable manner. The bellows 12 is constructed of metal and is non-thermal responsive in order that the accuracy of the timing device 10 will not be impaired when subjected to changes in temperature. The metal bellows is also flexible and resilient and in its normal shape is expanded into abutment with the top plate 17 of the frame 11. The plate 17 is apertured as at 20 (Fig. 2) for slidably receiving therethrough the vent valve construction 13. The vent valve 13 has a tubular casing 21 threaded exteriorly at one end for threaded engagement through the top wall of the bellows 12 and a reinforcing plate 22 thereon. The valve casing 21 is internally threaded at its upper end for receiving therein a valve of the "Schroeder" type which has an exteriorly threaded casing 23, a spring casing 24 connected to the casing 23 and which terminates at its lower end in an outwardly flared valve seat 25, a valve pin 26 having an outwardly flared valve head 27 for seating on the valve seat 25, and a coil spring 28 embracing the valve pin 26 within the spring casing 24 for normally maintaining the valve head against its seat. It will be noted that the upper end of the valve pin 26 extends above the top of the tubular casing 21.

Although the bottom of the bellows 12 may be directly connected to the base plate 16, it is preferred that a reinforcing plate 29 be interposed therebetween which, together with the base plate, forms a support for the air inlet mechanism 14.

The air inlet 14 includes a casing 30 having an exteriorly threaded tubular end threaded through registered and internally threaded openings in the base plate 16 and reinforcing plate 29. The casing 30 extends upwardly within the interior of the bellows 12 and is so shaped as to provide a tapered inner surface 31. An end wall 32 at the tapered end of the casing 30 is apertured as at 32.

The cylindrical end portion of the casing 30 is internally threaded for receiving therein a tapered restriction member 34 having a knurled actuating head 35 on one end thereof. One or more longitudinally extending grooves 36 (see Fig. 5) are provided transversely through the exterior threads on the restriction member 34 in order that air may flow from the atmosphere into the space between the tapered surfaces on the restriction member and the casing. The rate of airflow by the restriction member and through

the casing into the interior of the bellows 12 is dependent upon the size of the grooves 36, the area of the adjustable space between the restriction member and the casing, and the length of the casing whose inner surface offers resistance to flow of air therethrough.

The area between the restriction member and the casing may be varied by threading the restriction member inwardly or outwardly of the casing to vary the space between the tapered surfaces thereon. Knowing the volume of air desired to flow through the inlet 14, adjustments may be made of the restriction member 34 so that a predetermined interval of time will elapse before the volume will flow through the inlet. If desired, a scale as illustrated in Figure 6 may be provided on the bottom of the base plate 16 around the actuating head 35 so that an indicator 37, such as an arrow, may be set by rotation of the actuating head to effect the desired time interval for the flow of a given volume of air through the air inlet.

While the restriction member 34 has been illustrated as being adjustable, there may be provided, if desired, a series of restriction members each of which are sized so that when it is threaded into the casing with the actuating head thereof in abutment with the end of the casing a predetermined area between the restriction member and casing will be provided. By varying the size of each of the restriction members, the time interval for the flow of a given volume of air through the air inlet may be controlled. This type of restriction member would require the provision of a radial slot 38, as shown in dotted lines Figure 5, in the under side of the actuating head 35 in order for air to enter the casing through a groove 36. In this form of construction, as many grooves 36 are provided as there are longitudinally extending grooves 38.

A cross member or plate 39, shaped similar to the base plate 16 or the cover plate 17, has attached thereto a pair of spaced rod-like members 40 and 41. Connection of each of the rod members to the plate 39 is by any suitable means such as threading, riveting, welding, brazing or the like. The members 40 and 41 are so spaced as to telescopically engage within the vertical tubular supports 18 and 19 and are sufficiently longer than the vertical supports as to extend from both ends thereof. The lower ends of the rod members are threaded for receiving thereon the abutment nuts 42 and 43. Abutment plates 44 and 45 are connected to the lower side of the base plate 16 and are suitably apertured for slidably receiving therethrough the rod members.

A coil spring 46 embraces a portion of the rod member 40 adjacent the cross member 39 and has one end seated against the cross member and its other end seated on the cover plate 17. Likewise, a coil spring 47 embraces the rod member 41 in a position interposed between the cover plate 17 and the cross member 39. The coil springs urge the cross member 39 away from the cover plate 17 with the limit of relative movement therebetween being defined by the abutment between the nuts 42 and 43 and the abutment plates 44 and 45. It will be apparent that the distance between the cover plates 17 and the cross member 39 effected by the compression of coil springs 46 and 47 may be adjusted and varied by threading the nuts 42 and 43 longitudinally along the threaded end portions of the rod members 40 and 41.

As best shown in Figures 1, 2 and 3, a cam arm

48 has one end pivotally connected to the cross member 39 adjacent its under surface by a pivot 49, such as a cap screw or the like. The opposite end of the cam arm 48 extends over the portion of the valve pin 26 projecting outwardly of the casing 21 of the vent valve 13. As best shown in Figure 2, when the bellows 12 is in an expanded position and in abutment with the cover plates 17, the end of the valve pin 26 projecting from the casing 21 of the vent valve 13 is in abutment with the cam arm 48 whereby the valve head 27 has been urged away from the seat 25 to open the valve for communication of the interior of the bellows and the atmosphere.

A stop pin 50 extends downwardly from the cross member 39 against which the cam arm 48 abuts for positioning the latter directly over the valve pin 26 as shown in Figure 3. The position of the cam arm is normally maintained by a leaf spring 51 whose free end abuts against the cam arm and whose other end has a coil 52 for receiving therethrough a pin 53 for connecting the spring to the cross member 39.

A cam member 54 has an upper conical portion 55 and a reduced exteriorly threaded end portion 56 for connection with the cover plate 17. The cam member 54 is so positioned on the cover plate that its longitudinal axis is in alignment with an edge of the cam arm 48 (Figure 3). An opening 58 is provided in the cross member 39 in axial alignment with the cam member 54 for a purpose to be now explained.

When the timing device 10 is held so that manual pressure may be applied to the base plate 16 and the cross member 39, compression of the springs 46 and 47 is overcome, the cross member 39 is forced towards the cover plate 17, the cam arm 48 is forced into abutment with the end of the casing 21 to open the valve therein and the bellows 12 collapsed towards the base plate 16. As the vent valve 13 is opened and the bellows 12 collapsed, air in the bellows is vented through the vent valve.

The normal relative position of the parts is illustrated in full lines in Figure 4 and is the position of parts illustrated in Figures 1 and 2. When the cross member 39 has been urged towards the cover plate 17 to its limit of movement, the relative position of parts is illustrated in dotted lines in Figures 1, 2 and 4. As the cross member 39 moves downwardly, the conical portion 55 of the cam member 54 enters into the opening 58 and simultaneously the cam arm 48 moves downwardly along the sloping surface of the cam member whereby it is urged away from the stop member 50 and against the leaf spring 51. The limits of lateral movement of the cam arm 48 are shown in full and dotted lines in Figure 4. When the cam arm 48 has been moved laterally as shown in dotted lines in Figures 3 and 4, it has been moved out of alignment and abutment with the valve pin 26 and engages only an end portion of the valve casing 21. The coil spring 28 of the vent valve 13 urges the released valve pin 26 to a position in which the valve head 27 is seated against the valve seat 25 thereby closing the vent valve. However, engagement between the end of the casing 21 and the cam arm 48 maintains the bellows 12 collapsed until such time as manual pressure is released from the device.

A lock 59 is provided for maintaining the bellows 12 collapsed when manual pressure on the device is released. This lock construction includes a tubular member 60 slidably embracing

the upright tubular support 19. A laterally extending handle 61 is provided on the tubular member 60 for manual rotation thereof on the vertical support 19. A pin 62 extends outwardly from the vertical support 19 and seats within a slot 63 in the tubular member 60 whereby the handle 61 turns the tubular member 60 around the vertical support between predetermined limits defined by the length of the slot. This pin and slot coaction permits relative rotative movement but eliminates the possibility of any relative axial movement between the tubular member 60 and the vertical support. A locking portion 64 extends radially from the tubular member 60 in a direction opposite to the handle 61. A transverse slot 65 is provided in the locking portion so as to embrace an upwardly extending pin 66 carried by the top of the bellows 12. If desired, reinforcing plates 67 and 68 are provided on opposite sides of the bellows for receiving therein the press-fitted or otherwise secured end of the pin 66. An opening 69 in the cover plate 17 slidably receives therethrough the pin 66.

As shown in Figures 1 and 2, a pair of electrical contacts 70 and 71 are normally held spaced by a dielectric member 72 with the elements being connected to the under side of the cross member 39 by means of a rivet or screw 73. The contacts 70 and 71 are so positioned as to be in alignment with the pin 66. Conductors 74 and 75 connect the contacts 70 and 71 to an associated mechanism (not shown) to be started in operation when the circuit is closed through abutment of the contact 71 and the contact 70.

When the timing device 10 has been manually actuated whereby the cross member 39 is moved downwardly, the bellows 12 is collapsed and the air therein vented to the atmosphere. The vent valve 13 is then closed by cooperation of the cam member 54 and cam arm 48 and, if desired, the collapsed bellows is locked in position by actuation of the locking mechanism 59 to a position as illustrated in Figure 3. The air inlet 14 is then adjusted to the position in which a predetermined time interval elapses for the flow of air into the bellows 12 to take the place of the volume of air vented therefrom when the bellows has been released and expands towards the cover plate 17. As the vent valve 13 is closed when the device is manually actuated to an operating position, the collapsed bellows 12 may be locked by the locking mechanism and manual pressure released from the cross member 39 which is then urged to a projected position by the coil springs 46 and 47. Release of the locking mechanism permits the bellows 12 to expand upwardly towards the cover plate 17 and the time interval for the bellows to reach its fully expanded position is predetermined by the rate of airflow through the adjustable air inlet 14. The upward speed of the bellows 12 is controlled entirely by the rate of airflow through the air inlet 14.

When the top of the bellows 12 nearly approaches the cover plate 17, the extended end of the valve pin 26 engages the cam arm 48. Continued upward movement of the bellows causes the valve head 27 to be actuated away from its seat 25 thereby connecting the interior of the bellows to the atmosphere by a relatively large air inlet opening. The rush of a large volume of air into the interior of the not quite fully expanded bellows causes the latter to complete its expansion with a snap action. This snap action movement of the bellows at the

end of its expansion causes the pin 66 to snap the contact 71 into immediate engagement with the contact 70. This snap action of the contacts eliminates any possibility of arcing therebetween.

When the contact 71 has been moved into abutment with the contact 70 an electrical circuit connected thereto is closed whereby an associated mechanism may be started in operation. Consequently, the timing device 10 of this invention may be made operable for effecting a predetermined time interval before an associated mechanism is placed in operation.

Obviously, the same timing device may be made effective for placing an associated operating mechanism out of operation. This is effected by providing elements as illustrated in Figure 7. In this modified form of construction, an elongated opening 75 is provided in the cross member 20'. An electrical contact 76 is connected to an intermediate portion of an arm 77. An electrical contact 71' is aligned with the electrical contact 76, a dielectric member 78' is inserted between the ends of the arms carrying the contacts, and the elements are connected to the cross member 20' by means of a rivet or screw 78'.

As the pin 66 snaps upwardly, it engages the free end of the arm 77 to break the normal abutment engagement between the contacts 71' and 76. The elongated opening 75 is provided in the cross member 20' in order that the arm 77 carrying the contact 76 may be freely urged upwardly a distance sufficient to break the engagement between the contacts 71' and 76. This coaction of parts serves to open an electrical circuit defined by the conductors 74' and 75' whereby an associated mechanism in operation may be stopped.

The timing device 10 illustrated and described has been developed primarily for use with delayed action bombs although it is obviously usable with any mechanism for starting or stopping the latter by either opening or closing an electrical circuit. Obviously, the device is also capable of operation with mechanical linkage for starting and stopping an associated mechanism. Should mechanical linkage be substituted for an electrical circuit, the linkage would take the place of the electrical contacts with the pin 66 coacting with a lever member whose movement would be transmitted through the connected linkage.

It will be obvious from the foregoing that I have provided a timing device which is simple in construction, whose operation depends entirely on the control of the flow of air, and which is positive and accurate in its operation irrespective of the number of times the device is operated. It will also be apparent that the simplicity in design and construction of my timing device readily lends itself to mass production at a very nominal cost per unit.

While particular embodiments only of this invention have been illustrated, it will, of course, be understood that the invention should not be limited thereto, since many other modifications may be made and, therefore, it is contemplated by the appended claims to cover all such modifications as fall within the true spirit and scope of the present invention.

I claim as my invention:

1. A timer comprising a resilient hollow body, a vent valve for said body, an air inlet for said body defining an intake of smaller area than said

vent valve, means for collapsing said body for venting air therefrom through said vent valve to the atmosphere, said body partially expanding to a normally expanded shape by drawing air into the interior thereof from the atmosphere through said small air inlet, and means for opening said vent valve for communication between the atmosphere and the interior of said hollow body whereby the latter fully expands to said expanded shape by a snap action.

2. A timer construction comprising a resilient bellows, a vent valve for said bellows, an adjustable air inlet for said bellows defining an intake of smaller area than said vent valve, means for collapsing said bellows for venting air therefrom through said vent valve to the atmosphere, said resilient bellows expanding to a normal expanded shape by drawing air into the interior thereof from the atmosphere, and cam means for opening said vent valve for communication between the atmosphere and the interior of said bellows at a predetermined point during expansion of the bellows whereby the latter then expands with snap action.

3. A timer construction comprising a frame having relatively movable portions, a bellows carried by one of said frame portions, a pair of fluid bleeding means for connecting the interior of said bellows with the atmosphere, said frame portions being movable relative to each other for collapsing said bellows, said collapsed bellows expanding at a rate determined by fluid drawn through one bleeding means, and means on the other of said frame portions for actuating the other bleeding means whereby said bellows fully expands at a faster rate.

4. A timer construction comprising a frame having relatively movable portions, telescopic means connecting said frame portions, resilient means normally maintaining said frame portions in one spaced relation, a normally expanded bellows carried by one of said frame portions, a fluid inlet for said bellows, a fluid vent valve for said bellows, said bellows being collapsed when said frame portions are moved relative to each other whereby fluid in the bellows is expelled through said vent valve, said bellows expanding toward its normally expanded condition at a rate determined by said fluid inlet, and a cam member carried by the other of said frame portions for engagement by said vent valve to fully open the latter whereby said bellows then expands at a faster rate.

5. A timer construction including a movable valve construction, resilient means normally maintaining said valve construction in one position, means for moving said valve construction to another position, cam means between said valve construction and said last means for opening and closing said valve construction during movement to said other position, said cam means including an abutment member for opening said valve when said moving means moves said valve toward said one position.

6. A timer construction including a valve, spring means for normally maintaining said valve in one position, a member movable into abutment with said valve for moving the latter to another position, a cam member on said valve, a cam member on said abutment member, said cam members coacting to open and close said valve during movement thereof to said other position, said cam member on the abutment member engaging said valve to open the latter

when said spring means moves said valve toward said one position.

7. A timer construction comprising a supporting frame, a normally expanded resilient bellows carried by said supporting frame, a normally closed spring pressed vent valve for said bellows, an adjustable fluid inlet for said bellows, a member carried by said supporting frame for movement relative thereto, spring means normally maintaining said member in a projected position, said member being operable for collapsing said bellows, mechanism for holding said bellows collapsed and releasing said bellows therefrom, a cam member on said supporting frame having a sloping edge and a pivoted valve actuating member on said first member, said cam member and said pivoted valve actuating member cooperating to open and close said vent valve when said first member is moved to collapse said bellows, said valve actuating member being further operable for opening said valve when said bellows partially expands to its normally expanded condition.

8. In a timer, a valve member movable between predetermined limits, an actuating member for moving said valve, resilient means normally maintaining said actuating member in alignment with said valve for opening the latter when pressure is applied to said actuating member to move the valve to one of said limits, and a cam member engageable with said actuating member during said movement of the valve for moving said cam member out of alignment with the valve.

9. In a timer, a valve construction movable between predetermined limits, said valve construction having a spring pressed valve pin nor-

mally closing said valve and a tubular casing housing said pin, a movable actuating member, an arm pivotally carried by said actuating member, an abutment stop on said actuating member for limiting pivotal movement of said arm in one direction, a spring associated with said actuating arm for normally maintaining said arm in abutment with said stop and in alignment with said valve pin and said tubular casing, said arm moving said pin to open said valve and abutting said tubular casing for movement of the valve construction to one of its limits when said actuating member is moved, and a member having a sloping cam surface for engagement of an edge of said arm during said movement of the valve construction to said one limit for rocking the arm away from said stop and out of alignment with said valve pin whereby said arm engages only said tubular casing and said valve pin released to close said valve.

10. A contact actuating device comprising a resilient expansible and contractible hollow body, a contact operating member on said body urged toward contact operating position upon relative movement of said body in one direction, an inlet valve in said body controlling the initial rate of expansion of said body, a vent valve in said body to permit contraction thereof and also to permit rapid acceleration of said rate of expansion, and means controlled by said hollow resilient body to actuate the vent valve for said acceleration at a predetermined point in the expansion of said body.

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