July 26, 1966 C. FALLIS ET AL 3,262,323

CONTROL DEVICE

Filed July 21, 1964

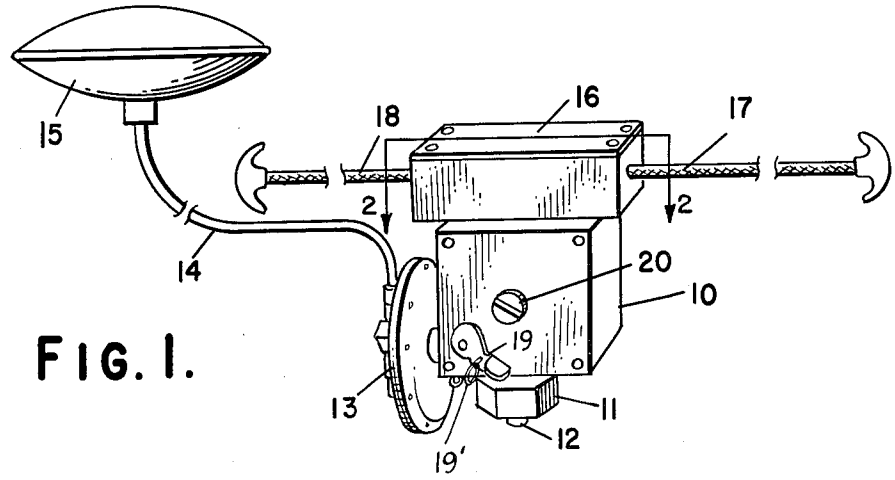


FIG. 1.

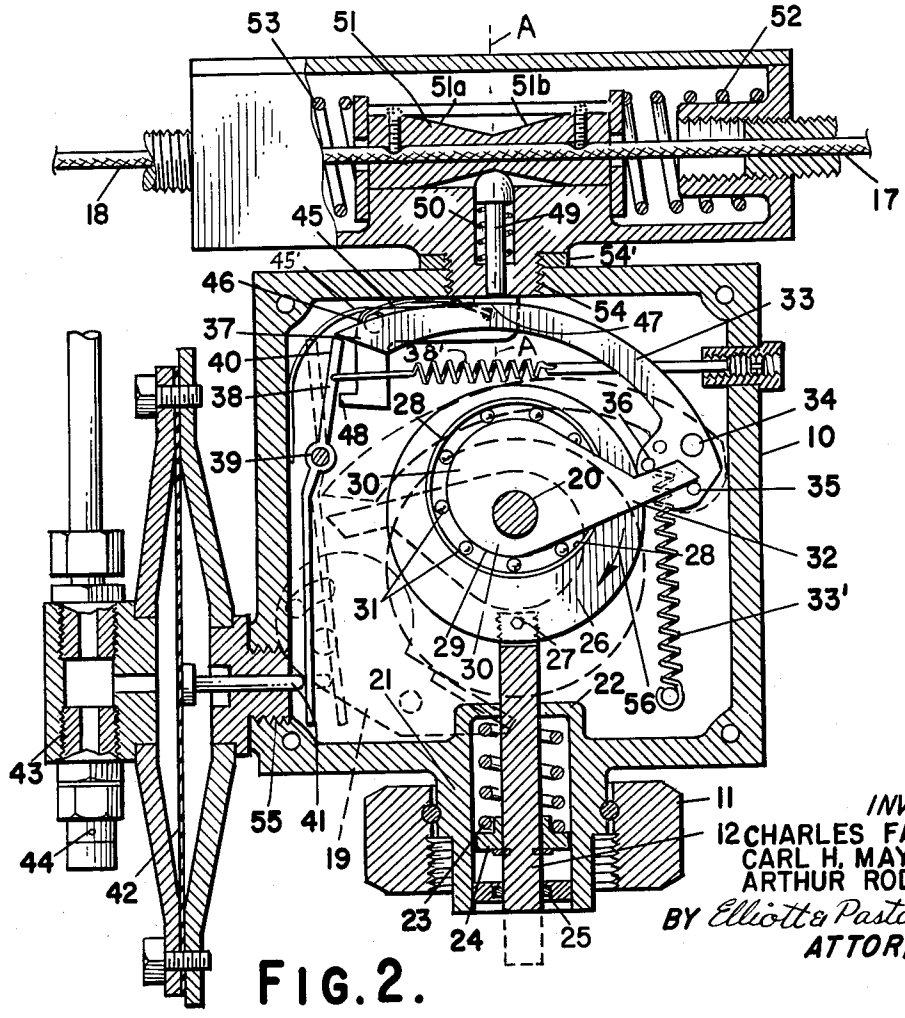


FIG. 2.

INVENTORS
CHARLES FALLIS
CARL H. MAYER JR.
ARTHUR RODGERS
BY Elliott & Pastoriza
ATTORNEYS

United States Patent Office 3,262,323 Patented July 26, 1966

3,262,323

CONTROL DEVICE

Charles Fallis, Park Ridge, Carl H. Mayer, Jr., Wilmette, and Arthur Rodgers, Northbrook, Ill., assignors to The Fire Guard Corporation, a corporation of Illinois

Filed July 21, 1964, Ser. No. 384,171
9 Claims. (Cl. 74—2)

This invention relates to an energy storing control device for providing a relatively large force in response to a small triggering force and more particularly, to such a device for actuating the valve on a fire extinguisher head assembly.

The proper design of control devices of the foregoing type entails several important considerations. It is necessary, of course, to store sufficient energy in the device to actuate the valve in question. Generally this involves no problem since a proper sized energy storing spring can be used and the device manually cocked with the necessary force. However, it is important that there be a very sensitive trigger means to release this stored energy which will only be actuated in response to a particular event, such as a sudden increase in temperature, and not responsive to any other exterior or environmental event such as could result from dropping the device, vibrations, etc.

It is also desirable in such a device that a means be provided for manually triggering the control. Towards this end, it is desirable to provide a manual control in which a positive force is necessary to operate the same so that inadvertent handling of the manual control will not result in unintentional release of the stored energy. The manual control accordingly should be designed to be much less sensitive than the thermal control. Moreover, such manual control should be operable from a remote location. Towards this end, cable assemblies, for example, have been proposed. However, with presently known cable assemblies, the direction in which the cable must be pulled has generally been fixed so that some limitation in the installation of the control device is present. In other instances, it may be desirable not to use any type of remote control and towards this end, it is important to be able to remove any such remote control and still use the device as a solely thermally responsive control.

Another important consideration in the design of a control device is to render it adaptable to different types of thermally responsive devices. For example, a diaphragm actuated structure is used in many instances, movement of the diaphragm being effected by expansion of gases due to a rapid temperature rise. The movement of the diaphragm in turn is designed to trigger the device. On the other hand, there may be provided electrically operated thermostats at remote locations, the signal therefrom serving to actuate a solenoid. Thus, a different type of connection would ordinarily be necessary to operate the control device. It is preferable to avoid any changes in the device when used with different controls.

In my co-pending patent application Serial No. 384,170, filed July 21, 1964, and entitled Control Device, there is disclosed a device in which the various foregoing design features are taken into consideration. However, this device as disclosed in my prior application is limited somewhat in its sensitivity in that operation is not always assured when the device is set to respond to extremely small triggering forces.

Accordingly, it is a primary object of this invention to provide a control device incorporating all of the versatile features and advantages of the control device described in my prior application and including additional features to provide greater reliability in response to extremely small triggering forces.

Another object, therefore, is to provide an extremely versatile control device adaptable to various forms and combinations of triggering devices responsive to fluid pressure pulses, electric current, remote cable actuation and the like.

More particularly, it is an object to provide a control device which will provide a large actuating force in response to a small triggering force in such a manner that only certain elements will serve to trigger the device and other environmental events such as shock, vibration, etc. will not trigger the device.

Another important object is to provide a novel manually operable cable assembly means to effect manual triggering of the device from a remote location and from any desired direction.

Still another object is to provide a unique trigger control for control devices responsive to thermally operated structures of either the diaphragm type or electrically operated type, or stored pressured type.

Briefly, these and many other objects and advantages of this invention are attained by providing a housing including an actuating rod protruding from one end. This rod is arranged to move from a raised set position to a lowered released position to provide the desired large actuating force to operate a fire extinguisher head assembly or any other equivalent valve structure. The inner end of the rod within the housing terminates in a coupling eye structure mounted to a disc in turn eccentrically secured to a shaft. The arrangement is such that rotation of the shaft will serve to cam the eye from a lower position to an upper position to cock or store energy within the device. Towards this end, there is provided a strong compression spring which is compressed upon movement of the actuating rod from its lower or most extended position to its retracted position. By using an eccentric arrangement movable towards an over-center position, a large amount of energy may be stored and yet the required force to release this energy approaches zero as the eccentric disc approaches the over-center position. This disc includes a laterally extending latch arm which is adapted to be engaged by a pivoted latch lever. By adjusting the device such that positioning of the eccentric disc is at substantially over-center position, zero force is exerted on the latch lever. A trigger element is provided and the latch lever biased with an adjustable spring to engage the trigger element. Movement of the trigger element will then release the latch lever to in turn permit the latch lever to move the latch arm positively in a direction to release the energy stored in the compression spring.

The foregoing arrangement is advantageous in that the necessary triggering force can be adjusted independently of the degree of compression of the main energy storing compression spring by simply adjusting the latch lever spring.

Other important features of the invention relate to the provision of a novel cable actuator assembly adapted to operate the trigger element when a cable is pulled and so mounted to the housing that the direction of pull may be varied as desired. Further, the housing includes a coupling adapted to receive either a diaphragm type thermal control or electrically operated thermostat solenoid structure. In either event, the trigger element is responsive to a movable member to release the latch lever so that the adaptation of the diaphragm type or solenoid type of thermal control may readily be achieved.

A better understanding of the improved control device of this invention will be had by now referring to a preferred embodiment thereof as illustrated in the accompanying drawings, in which:

FIGURE 1 is a perspective view of the control device of this invention; and

FIGURE 2 is an enlarged cross section of the device taken generally in the direction of the arrows 2—2 of FIGURE 1.

Referring first to FIGURE 1, the device comprises a housing **10** including a lower coupling nut **11** and an actuating rod **12**. The lower end of the rod **12** is visible in FIGURE 1 as protruding from the coupling nut **11**. When the actuating rod **12** is in a raised position within the housing, energy is stored and when the device is triggered, the actuating rod moves from its raised to a lowered released position to provide the desired large magnitude force to operate auxiliary valves and the like.

Several means are provided for intentionally triggering the structure to release the energy stored within the housing **10**. The most important of these comprises a thermally responsive device in the form of a diaphragm casing **13** connected through a flexible pressure conduit **14** to a closed volume **15**. The closed volume **15** may be disposed in any area in which a fire is liable to break out. The design is such that a rapid or extraordinary rise in temperature will result in a rate of expansion of the gas within the closed volume **15** sufficient to move the diaphragm within the casing **13** in a direction to trigger the structure in the device **10**. With the device coupled to the top of a fire extinguisher head assembly by means of the coupling nut **11**, the resulting downward movement of the actuating rod **12** will trigger the fire extinguishing device. A small air bleed is provided from the closed volume **15** so that normal environmental temperature changes will not move the diaphragm to trigger the structure within the housing **10**.

To provide manual remote control of the triggering, there may be provided, for example, a cable actuator assembly **16** including first and second cables **17** and **18** extending in opposite directions therefrom. The arrangement is such that pulling on either of the cables **17** or **18** will serve to trigger the structure within the housing **10**. In accordance with a further feature, the cable actuating assembly **16** may be swivelly mounted to the top of the housing **10** so that the direction of pull of the cables may be changed as desired.

Still another control may be provided in the form of a manually pivotable lever **19** normally locked against movement to the housing **10**. However, removal of the locking key **19'** to permit rotation of the manual lever **19** will enable the device to be triggered by moving the lever.

Except for the foregoing means for triggering the structure within the housing **10**, it is not possible to otherwise actuate the device. Thus, hammering or dropping or general vibrations exerted on the housing **10** will not release the energy stored therein.

After triggering, the device may be reset by rotating a center shaft **20**. This operation as well as other features of the invention will be better understood by now referring to the enlarged cross section of FIGURE 2.

Referring first to the lower portion of FIGURE 2, there is provided an integral fitting **21** to which the nut **11** is rotatably keyed and which terminates at its upper end within the housing **10** in an inturned flange **22**. This flange supports the upper end of a compression spring **23** serving as the energy storing medium for the device. The lower end of the compression spring **23** seats on an annular stop **24** secured to the actuating rod **12**. An annular guide **25** for the lower end of the rod is secured to the fitting **21** as shown. The arrangement is such that the nut **11** may be threaded over the upper nipple portion of a fire extinguisher head assembly so that downward movement of the actuating rod **12** from the solid to the dotted line position transfers the stored energy to actuate the fire extinguisher.

The movement of the actuating rod **12** is achieved by mechanism in the central portion of the housing **10**. This mechanism includes an eye structure **26** threaded to the upper end of the actuating rod **12** and locked by set screw **27**. The eye **26** defines a central opening **28** including an inner bearing race **29**. A disc **30** is rotatably mounted by bearings **31** within the race **29** as shown. The disc **30** is eccentrically connected to the shaft **20** which in turn is rotatably mounted to the housing **10**. A latch arm **32** extends laterally from the disc **30**.

With the foregoing arrangement, it will be clear that rotation of the shaft **20** will serve to move the disc **30** from a position in which its center is below the shaft **20**, as shown in dotted lines, to a position in which its center is above the shaft **20** as shown in solid lines. In the particular solid line illustration of FIGURE 2, the various elements are in their set or cocked position in which the actuating rod **12** is in its set raised position. If the disc **30** is free to rotate, and assuming that the center of the disc **30** is slightly to the right of a vertical line passing through the shaft **20** so as not to be quite in an over-center position, the disc **30** will rotate in a clockwise direction until its center is below the shaft **20** to assume the dotted line position. In this position, the actuating rod **12** is in its lowered released position. Thus, in setting or cocking the device, the shaft **20** is rotated in a counterclockwise direction until the latch arm **32** assumes the solid line position shown.

It should be pointed out that rod **12** has a loose fit in flange **22** and in annular guide **25** to accommodate slight lateral movement of rod **12** as a result of the circular motion of eccentric **30** and eye structure **26**.

A latch lever **33** pivoted to the housing at **34** includes small lower and upper projections **35** and **36** arranged to be positioned on either side of the end of the latch arm **32** when the latch arm **32** is in its solid line position as shown. If the latch arm and disc **30** are not rotated to an exact over-center position but rather slightly to one side of the over-center position such as to the right, the latch arm **32** will rest against the lower projection **35** on the latch lever **33**. On the other hand, if the latch arm **32** and disc **30** are rotated beyond the over-center position, the upper end of the latch arm **32** will rest against the upper projection **36** on the latch lever **33**. Therefore, so long as the latch lever **33** is in the solid line position shown, the latch arm **32** is "caged" or effectively prevented from rotating in either direction.

The latch lever itself curves about to define an extended lever portion terminating adjacent the upper left-hand portion of the housing at **37**. A trigger element **38** is centrally pivoted at **39** and has an upper end **40** arranged to engage under the end **37** of the latch lever as shown. A latch lever spring **33'** for the latch lever **33** is secured to the latch lever slightly to the left of the central pivot **34** at its upper end and has its lower end secured to the housing so that the latch lever **33** is biased to rotate in a counterclockwise direction about the central pivot **34**. There is thus a small force exerted by the end **37** of the latch lever on the upper end **40** of the trigger element **38**.

With the foregoing arrangement, it will be evident that if the trigger element **38** is pivoted about its central pivot **39** towards the dotted line position so that its upper end disengages the end **37** of the latch lever **33**, the latch lever **33** will then be free to rotate about the pivot **34** as a consequence of the force exerted by the spring **33'**. This rotative action will remove the lower projection **35** from under the latch arm **32** and cause the upper projection **36** to strike the upper portion of the latch arm **32** and exert a positive force rotating the latch arm **32** and disc **30** in a clockwise direction as viewed in FIGURE 2. Accordingly, regardless of the actual position of the latch arm **32**; that is, whether it is slightly to the right of over-center position, substantially at over-center position, or slightly to the left of the over-center position, it will always be positively moved upon release of the latch lever by the trigger element as a consequence of the positive striking of the projection **36** against the latch arm **32** to move in a clockwise direction and thus permit the compression spring to release its energy.

It will be evident from the above description that the sensitivity of the device may be very accurately adjusted. Since the force exerted by the end of the latch lever **33** against the trigger element **38** is substantially independent of the position of the latch arm, this force may be controlled by the latch lever spring **33'**. In addition, the trigger element **38** is provided with a trigger element control spring **38'**, the tension of which may be adjusted to in turn adjust the engaging force of the upper end **40** of the trigger element against the end **37** of the latch lever. By properly adjusting the forces exerted by these two springs, the degree of force necessary to be exerted on the lower end **40'** of the trigger element to disengage from under the end **37** of the latch lever **33** may be very accurately controlled. Once this end **37** of the latch lever **33** is released, the action, as described above, will take place to provide the desired actuating force by the compression spring.

The diaphragm casing **13**, as shown in enlarged cross section in FIGURE 2, is so positioned that the lower end **40'** of the trigger element **38** will be engaged by a movable member **41** connected to a diaphragm **42**. The other side of the diaphragm in turn is in communication with the closed volume **15** illustrated in FIGURE 1 through the conduit **14** by means of a coupling cylinder **43**. The lower end of the cylinder **43** includes a small air bleed **44** so that slow rates of change of pressure within the closed volume will not move the diaphragm **42** but only a sudden change in pressure as would be caused by a rapid temperature rise is effective to actuate the diaphragm.

From the foregoing description, the operation of the components described thus far will be clear. Thus, a rapid rise in temperature to move the diaphragm **42** to the right and thus move the movable member **41** to the right will serve to rotate the trigger element **38** in a counterclockwise direction causing the upper end portion **40** to disengage from under the end **37** of the latch lever. Release of the latch lever will then result in the projection **36** striking the latch arm **32** as described so that the latch arm **32** and disc **30** will rotate in a clockwise direction to assume the dotted line position shown and result in the movement of the actuating rod **12** from its solid to dotted line position. This movement of the actuating rod will then effect any desired function such as turning on a fire extinguisher.

In re-cocking the device, the shaft **20** is rotated in a counterclockwise direction as explained in conjunction with FIGURE 1 until the latch arm **32** engages the projection **36** to lift the latch lever **33**. The end **37** of the latch lever **33** will then ride past the trigger element **38** until the end **40** of the trigger element is free to snap under the end **37** and support the latch lever. If the movable member **41** has been retracted, there is sufficient room for the lower end **40'** of the trigger element **38** to move, the end of the movable member **41** serving as a stop for the trigger element. The spring **38'** as explained heretofore, biases the trigger element generally in the desired direction to engage under the latch lever end **37**.

Referring now to the upper portion of FIGURE 2, the cable actuator assembly will be described in detail. As shown, there is provided an actuating element in the form of an inverted L structure **45** pivoted at **46** and including one end portion **47** disposed beneath the center top portion of the housing **10**. The other end portion of the inverted L is indicated at **48** and is adapted to engage the trigger element **38** adjacent its upper end portion **40** upon rotation of the L about its pivot **46**.

Thus, downward movement of the upper end **47** of the L will result in lateral movement to the left of the other end **48** thereby causing the trigger element to disengage from under the latch lever **33**. A spring **45'** is provided to bias the L shaped member in a direction to avoid bearing against the trigger element **38** unless an intentional force is applied to the upper end **47**.

To provide an intentional force, the cable actuator assembly includes a plunger at **49** biased upwardly by a compressor spring **50**. The upper end of the plunger terminates against the mid-section of a slide member **51** including inwardly tapered surface walls defining conical surfaces **51***a* and **51***b* meeting in the central portion of the slide member. The arrangement is such that movement of the slide member **51** in either the left or right hand direction will result in one or the other of the surfaces camming the plunger **49** in a downward direction thereby engaging the end **47** of the L shaped member **45** and thus triggering the device.

The movement of the slide member **51** may be achieved by either one of the cables **17** or **18**, the slide member itself being biased to a central position by suitable springs **52** and **53**. By adjusting the forces exerted by the various springs such as the plunger compression spring **50** and the springs **52** and **53**, the manual pull force on either one or the other of the cables may be adjusted to adjust the sensitivity of the triggering action by the cables.

A feature of the structure described in conjunction with the cable actuator assembly resides in the threading of the assembly in a threaded opening **54** and using an expandable type washer **54'** such that the cable assembly housing may be rotated and yet a proper seal maintained over the opening. By this arrangement, and because of the symmetry of the plunger element **49** about the vertical axis A—A, the direction at which the cables **17** and **18** extend from the housing **16** may be varied as desired.

Another feature of the use of a threaded opening **54** resides in the ease with which the cable actuator assembly **16** may be completely removed and the opening **54** simply plugged by a suitable close-off cap.

By also providing a threaded opening **55** on the left side of the housing **10** for the diaphragm casing **13** and by positioning the trigger element **38** to be operated by a movable member concentric with this opening, a solenoid may readily be substituted for the diaphragm structure with the solenoid plunger performing the function of the movable member **41**.

It will also be appreciated other triggering means well known in the art may be coupled to openings **50** and **51**. Briefly, automatic triggering could be effected by a diaphragm, a thermostat actuated solenoid, or a pressurized piston activated by a fusible link cartridge operator. A manual remote means could comprise a cable actuator, solenoid (actuated by push-button), or a pressure pulse from a push-pull station. Any of these devices could be coupled at either **50** or **51**.

Thus, while only one specific embodiment of the invention has been set forth and described, it will be evident that various changes and substitution of equivalent elements may be effected by those skilled in the art without departing from the scope and spirit and of the invention. The improved control device is therefore not to be thought of as limited to the one embodiment set forth merely for illustrative purposes.

What is claimed is:

1. A control device for providing a large actuating force in response to a small triggering force comprising, in combination: a housing; an actuating rod having a lower end protruding from the lower end of said housing; a compression spring biasing said actuating rod from a raised set position to a lowered released position to provide said large actuating force, the upper end of said rod terminating in a coupling eye within said housing, said coupling eye having a central circular opening; a disc received within said circular opening and having a latch arm extending radially therefrom; a shaft eccentrically secured to said disc and mounted to said housing for rotation about an horizontal axis so that rotation of said shaft from a first position in which the center of said disc is below said shaft to a second position in which the center of said disc is above said shaft, moves said actuating rod from its released position to its set position to compress said compression spring; a latch lever pivoted intermediate its ends

in said housing and including at one end spaced projections positioned on opposite sides of said latch arm to hold said shaft and disc in said second position; biasing means biasing said latch lever in a direction to move said projections from said latch arm; and trigger means engaging the other end of said latch lever to block pivoting movement thereof and responsive to said triggering force to disengage said latch lever so that rotation of said latch lever by said biasing means moves one of said projections positively against said latch arm to start rotation of said latch arm and disc so that said compression spring moves said actuating rod from its set to released position to provide said large actuating force.

2. A control device according to claim **1**, in which said housing includes an upper opening receiving a cable actuator assembly, said cable actuator assembly including two cables extending in opposite directions from said assembly and a central plunger received in said opening and responsive to pulling of either one of said two cables to move downwardly into said opening; and a pivoted member in said housing responsive to downward movement of said plunger into said opening to actuate said trigger means.

3. A control device according to claim **2**, in which said cable actuator assembly is mounted to said opening for swiveling movement so that said cables can be pulled from any desired direction.

4. A control device according to claim **3**, in which said cable assembly includes a slide member having opposite ends connected to said cables respectively and radially inwardly tapered sidewalls meeting at the center of the member to define a pair of conical surfaces, said plunger being cammed in a downward direction by one of said conical surfaces upon sliding movement of said slide member in one direction and by the other of said conical surfaces upon sliding movement of said slide member in the other direction.

5. A control device according to claim **4**, in which said housing includes a side opening receiving a thermally operated assembly including a movable member receivable through said side opening in a position to engage a portion of said trigger means, said assembly being responsive to a given rate of temperature increase to move said member inwardly to actuate said trigger means.

6. A control device according to claim **5**, in which said thermally operated assembly includes a pressure diaphragm, one side of which is connected to said movable member and the other side of which is subjected to gas pressure in a closed volume, said closed volume having an air bleed such that only said given rate of temperature increase will provide sufficient pressure from thermal expansion against said diaphragm to actuate said triggering means.

7. A control device according to claim **6**, in which the projections on said latch lever are positioned so that said latch arm is positioned substantially mid-way between said projections when said disc and latch arm are initially rotated to an exact over-center position so that the engaging force of said latch lever on said trigger means is substantially independent of forces exerted by said compression spring.

8. A control device according to claim **7**, in which said movable member for said thermal assembly is positioned to engage upon movement the end of said trigger element opposite to its engaging end so that inward movement of said end results in the outward movement of said engaging end to release said latch lever.

9. A control device according to claim **8**, including a trigger element spring connected between said trigger element and said housing for biasing said trigger element such as to urge said lower end into engagement with said movable member.

References Cited by the Examiner

UNITED STATES PATENTS

2,333,130	10/1943	Thomsen	74—2
2,466,750	4/1949	Thomsen	74—2
2,923,160	2/1960	Ault	74—2

MILTON KAUFMAN, *Primary Examiner.*