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E. J. DILLMAN

2,466,583

TRIP MECHANISM

Filed May 3, 1945

2 Sheets-Sheet 1

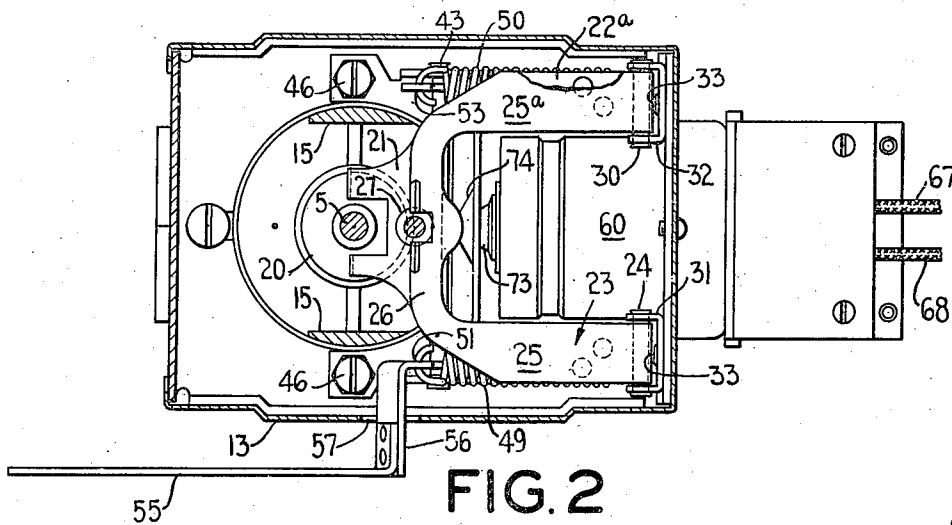


FIG. 2

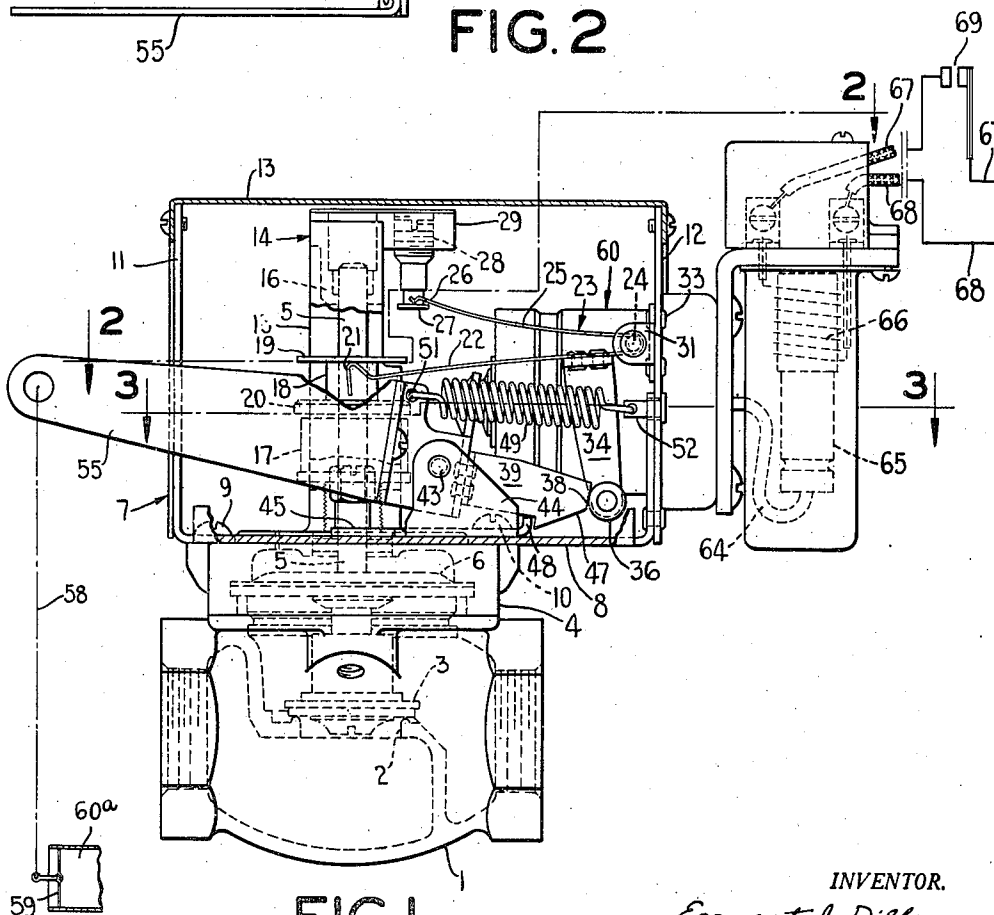


FIG. 1

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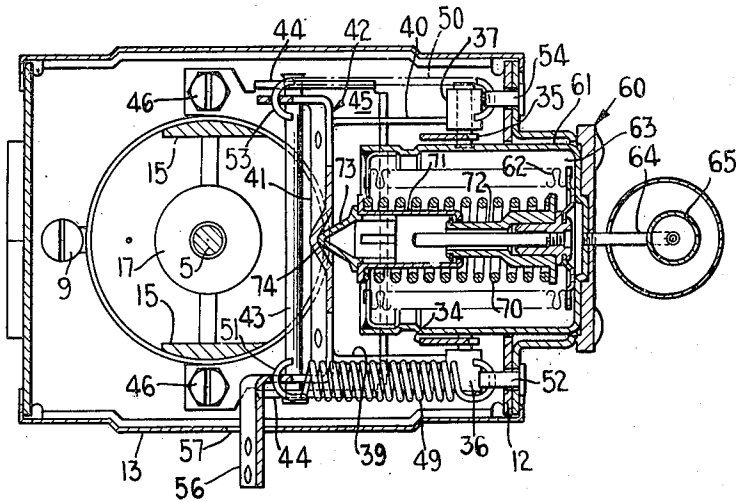


FIG. 3

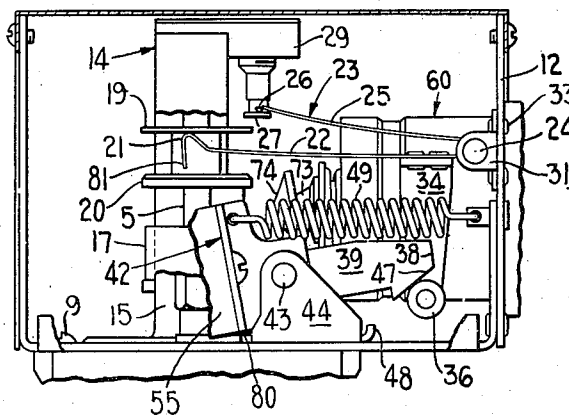


FIG. 4

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TRIP MECHANISM

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11 Claims. (Cl. 74-2)

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This invention relates to devices for controlling the flow of fluids and more particularly to operating means for a valve and a damper for controlling respectively the supplies of gaseous fuel and combustion air to a burner.

An object of the invention is to provide a novel valve operating means of compact construction.

Another object is to provide means by which the valve is quickly moved to and from its seat when adjacent thereto so as to eliminate "flashing-back" at the burner.

Another object is to provide means by which the damper will be opened prior to opening of the valve.

The invention consists in the novel arrangement and cooperative relation of parts to be more fully described hereinafter and the novelty of which will be distinctly pointed out and particularly claimed.

In the accompanying drawings, to be taken as a part of this specification, there is fully and clearly illustrated a preferred embodiment of the invention, in which drawings,

Figure 1 is a view in front elevation of the valve and damper operating means mounted on the valve casing and with the front housing wall broken away to show internal construction,

Fig. 2 is a view in section on the line 2-2 of Fig. 1,

Fig. 3 is a view in section on the line 3-3 of Fig. 1,

Fig. 4 is a detail view in front elevation of the operating means showing it in valve opening position.

Referring to the drawings by characters of reference 1 designates generally a valve casing having a passageway therethrough for flow of a gaseous fuel to a burner, not shown, and containing a valve port 2 which is controlled by a valve member 3. The casing 1 has a bonnet 4 which is apertured for passage of the valve stem 5 therethrough. A diaphragm 6 is sealed at its periphery in the bonnet 4 and surrounds and is sealed to the stem 5 to close the stem aperture from the casing 1. The stem 5 extends out of the casing 1 and into a housing 7 which is mounted on the bonnet 4. The housing 7 has a bottom wall 8 secured to the bonnet 4 by screws 9 and 10. Rising from the ends of the bottom wall 8 there are end walls 11, 12, which receive an inverted U-shaped cover member 13 forming the front, rear and top walls of the housing. Extending upward into the housing 7 from the bonnet 4 there is a supporting structure 14 formed by side posts 15 and a top

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bridge piece 16 having an aperture therethrough through which the stem 5 is guided at its upper end. Surrounding the stem 5 there is a cylindrical permanent magnet 17 having a longitudinal aperture therethrough in which the stem 5 passes freely. The magnet 17 is adjustably mounted on the supporting structure 14 between the posts 15. Fixed on the stem 5 there is a collar 18 having an upper flange 19 and a lower flange 20 which is an armature cooperable with the magnet 17.

Extending between the flanges 19 and 20 there is one end 21 of the lower arm 22 of a leaf spring 23 which is bent intermediate its ends about a supporting rod 24 such that the upper spring arm 25 overlies the arm 22 providing in side elevation a generally U-shaped or hair pin type spring. The free end 26 of the upper arm 25 is supported by a screw abutment member 27 which is adjustably screw threaded as at 28 in a horizontal extension 29 projecting from the bridge portion 16. The spring 23 in plan view is also of U-shaped form having lower and upper arms 22^a, 25^a respectively spaced horizontally from the arms 22, 25 respectively. The upper arms 25, 25^a are joined by the end portion 26. The lower arm end portion 21 joins the lower arms 22, 22^a. The arms 22^a, 25^a are supported at their juncture with each other by a horizontal rod 30. The rods 24 and 30 are supported by brackets 31, 32 respectively which are secured to the inside face of the end wall 12 as by rivets 33 for example. Riveted to the lower arms 22, 22^a adjacent the rods 24 and 30 there are downward extending lever arms 34, 35 respectively which terminate adjacent the bottom wall 8. Extending laterally from the lower free ends of the arms 34 and 35 there are cam followers 36, 37 respectively formed by stub shafts secured to the arms and each carrying a cam roller. Abutting the cam followers 36, 37 are the end faces 38 of a pair of lever arms 39, 40 joined by a cross member 41 of a generally H-shaped lever 42, see Fig. 3. A shaft 43 extends through aligned openings in the lever arms 39, 40 to pivotally support the lever 42. The ends of the shaft 43 are supported in ears or flanges 44 turned up from the side edges of a supporting plate 45 which is secured to the top face of the bottom wall 8 by the screw 10 and screws 46 which also secure the wall 8 to the bonnet 4 and the bonnet 4 to the lower part of the casing 1. The shaft 43 extends transverse to the valve stem 5 and underlies the spring supporting member 27. The lever arms 39 and 40

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have inclined cam faces 47 which lead to the end faces 38 and which are upwardly inclined toward the end wall 12. The lever arms 39 and 40 are limited in downward movement by a stop flange 48 turned up from the plate 45. The flange 48 stops the clockwise rotation of the lever 42 in a position with the lever end faces 38 in the path of movement of and in abutting engagement with the cam followers 36, 37 so that the arms 34, 35 are locked against movement away from the wall 12. The end faces 38 are preferably arcs struck from the center of the shaft 43 so that the arms 34, 35 are held stationary until the lever 42 has been rocked or rotated counterclockwise sufficiently to bring the followers 36, 37 against their respective cam faces 47. The lever 42 is held against the stop flange 48 by a pair of helical coil springs 49 and 50. The spring 49 has one end anchored as at 51 in an aperture through the lever arm 39 above the shaft 43 and has its other end anchored to a head pin 52 secured through an aperture in the end wall 12. The spring 50 has one end anchored as at 53 in an aperture through the lever arm 40 above the shaft 43 and has its other end anchored to a head pin 54 secured in an aperture through the end wall 12. The springs 49 and 50 extend substantially horizontally and are under tension to hold the lever 42 resiliently against the stop flange 48. Extending from the arm 39 there is a damper operating arm 55 which is offset as at 56 from the arm 39 so as to pass through an aperture 57 in the front wall of the cover member 13. The arm 55 is connected in any suitable manner by linkage 58 to an air damper 59 controlling flow of combustion air through a duct 60^a connected to the fuel burner as is well understood in the art.

Secured in and through an aperture in the end wall 12 there is a heat motor power element 60 having a cup-shaped casing 61 cooperable with a pressure operated bellows member 62 to form a pressure chamber 63. Sealed through the end wall of the casing 61 and communicating with the chamber 63 there is one end of a capillary tube 64 which has its other end connected to a boiler or bulb element 65 which is vertically positioned and has at its upper end a surrounding electric heating coil 66. The terminals of the coil 66 are connected by lead wires 67, 68 to a source of a current supply. Current flow to the coil 66 is controlled by a switch 69 which may be positioned in the wire 67 and be thermostatically actuated in response to temperature created by the burner. The chamber 63, tube 64 and bulb element 65 are filled with a volatile liquid such that when the coil 66 is energized to heat the bulb element 65, liquid will be forced into the chamber 63 thereby moving the responsive member 62 outward. Interconnecting the member 62 and the lever 42 there is a thrust member 70 which is a helical coil spring seating at its opposite ends against flange abutments on the end portions 71, 72 of a longitudinally collapsible guide rod which extends longitudinally through the spring 70. The end portion 72 is secured in abutting engagement with the head or end wall of the pressure responsive member 62. The portion 71 has a conical end 73 which seats in a conical recess 74 formed in the lever cross member 41 substantially in the plane of the springs 49, 50 and above the shaft 43.

The operation is as follows: When the heating coil 66 is deenergized and the parts are in the positions shown in Figs. 1, 2 and 3, the leaf spring 23 will have its upper arms 25, 25^a flexed convexly

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downward and under tension between the supporting members 24 and 30 at one end of the upper arms and the supporting member 27 at the other end of these arms. The lower arms 22, 22^a will be flexed downward away from their upper arms and be tensioned between the arms 34, 35 and the adjacent supporting members 24, 30 respectively by the longitudinal rocking or swinging of the arms 34, 35 by the lever 42. The free end portions of the lower arms 22, 22^a are flexed downward by the magnetic force of the magnet 17 acting on the armature 20. The spring 23 is therefore held under tension with sufficient force stored in the upper arms 25, 25^a to lift the free end 21 against the force of the magnet 17 and to lift the valve member 3 to open position against the force of gravity which biases it to closed position. When the switch 69 is closed, the coil 66 will heat the liquid in the bulb element 65 and drive the liquid therefrom into the power element chamber 63. This will move the responsive member 62 outward and the thrust member 70 acting through its end portion 73 will rotate the lever 42 counterclockwise facing Fig. 1 and against the force of the springs 49 and 50. The lever 42 will hold the arms 34 and 35 against rocking movement away from the wall 12 under the force of the tension upper spring arms 25, 25^a until the end faces 38 are lifted above or out of the path of movement of the followers 36, 37. During this movement of the lever 42, the damper arm 55 will have been swung downward thereby moving the air inlet damper 59 to an open position sufficient to supply the necessary air for the initial quick opening movement of the valve member 3.

As the followers 36, 37 ride onto the cam faces 47, the force stored in the upper spring arms 25, 25^a will be transferred to the lower spring arms 22, 22^a, tensioning the free end portion 21 upward against the flange 19. As soon as the lifting movement of the lever cam faces 47 has permitted a sufficient transfer of force from the upper spring arms to the lower spring arms to overcome the force of the magnet 17, then the force transferred to the lower spring arms will snap the valve stem 5 upward and open the valve member 3 to its minimum desired flow position so that gaseous fuel will be supplied through the port 2 to the burner. Rotation of the lever 42 under the force of the power element 60 is continuing so that the cam faces 47 are continuing their upward movement which permits the followers 36 and 37 to rock further away from the wall 12 with consequent further transfer of force from the upper spring arms to the lower spring arms thereby continuing the opening movement of the valve member 3. This rotation of the lever 42 will continue until the under side of the lever arm 39 adjacent the offset 56 engages the plate 45 as at 80. The power element spring 70 provides for lost motion when the lever 42 has been stopped in its valve opening movement in the event there is further expansion of the chamber 63.

When the switch 69 is opened to deenergize the coil 66, the bulb element 65 will cool thereby permitting the springs 49 and 50 to rotate the lever 42 clockwise from its position of Fig. 4 toward the position of Fig. 1. As the arms 39 and 40 move downward, the cam faces 47 will force their respective followers 36, 37 toward the end wall 12 thereby rocking the lever arms 34, 35 in a counterclockwise direction. This swinging or rocking of the arms 34, 35 will pull the free end 21 of the leaf spring 23 downward and will simultaneously

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flex the upper spring arms 25, 25^a convexly downward tensioning the upper arms downward against the supporting members 27 and 24, 30. Downward movement of the spring end 21 will permit the valve member 3 to move downward by gravity. It may be well to note that if the valve member 3 should stick in open position that the down turned spring end 21 will engage the armature flange 20 and force the valve member toward closed position. When the cam faces 47 have forced the followers 36, 37 substantially out of the path of downward movement of the lever 42, that is, substantially to a position where the lever end faces 38 will ride downward on the followers 36, 37, the armature 20 will have been permitted to come sufficiently close to the magnet 17 so that the magnetic force will overcome the resiliency of the lower spring arms 22, 22^a and snap or quickly move the valve stem 5 downward and the valve member 3 to full closed position. During this valve closing movement the damper arm 55 will be moving upward thereby moving the damper 59 toward closed position. When the valve member 3 is snapped to full closed position the damper 59 will still be somewhat open and therefore continued movement of the damper arm 55 is required in order to close the damper. After the valve member 3 is closed the springs 49 and 50 will continue the clockwise rotation of the lever 42 forcing the followers 36 and 37 off the ends of the faces 47 and out of the path of movement of the lever 42 so that the continued lever movement into engagement with the stop flange 48 merely causes the lever end faces 38 to ride downward on the followers 36, 37 without imparting additional rocking movement of the lever arms 34, 35 toward the wall 12.

What is claimed and is desired to be secured by Letters Patent of the United States is:

1. In a control device, a member normally biased in one direction and having a stem, a leaf spring engaging said stem and holding said member against movement in said one direction, an arm secured to said spring and having a lateral flange, and a lever having a cam portion engageable with said flange and operable to rock said arm longitudinally of said spring thereby to flex said spring for movement of said member in said one direction, said lever having an end face portion leading from said cam portion and engageable with said flange upon movement of said flange beyond said cam portion, said end face portion being contoured to provide lost motion of said lever relative to said arm and to hold said arm substantially in stationary position.

2. In a control device, a reciprocal member normally biased in one direction and having a stem, spaced supporting members, a leaf spring having a bridging portion extending between said supporting members and having an end portion extending into operative engagement with said stem, an arm extending from said spring end portion and operable on rocking movement to flex said end portion relative to said bridging portion so that said end portion is moved for movement of said reciprocal member, a lever engaging said arm, a spring acting through said lever and operable to move said lever to rock said arm, and a power element acting on said lever and operable to move said lever against the force of said last-named spring.

3. In a control device, a reciprocal member normally biased in one direction, spaced supporting members, a leaf spring having a bridging

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portion extending between said supporting members and having an end portion extending into operative engagement with said reciprocal member, an arm extending from said spring and operable on rocking movement to flex said bridging portion so that said end portion is moved for movement of said reciprocal member, a lever engaging said arm, a spring acting through said lever and operable to move said lever to rock said arm, and a power element acting on said lever, said power element having a pressure responsive member and having a coil spring transmitting movement from said responsive member to said lever and operable to move said lever against the force of said last-named spring.

4. In a control device, a reciprocal member biased to one position and having a stem, a supporting rod transverse to said stem, a U-shaped leaf spring bent about said rod and having upper and lower arms, a supporting member for the free end of said upper arm, said lower arm extending into operative engagement with said stem for moving said reciprocal member to another position, a lever arm extending downward from and secured to said lower spring arm adjacent said rod, said lever arm having its free end swingable longitudinally of said spring and toward said rod to tension said upper spring arm and to flex said lower spring arm downward for movement of said reciprocal member toward said one position, an armature on said stem, a magnet cooperable with said armature and tending to hold said reciprocal member in said one position, said magnet flexing said lower spring arm downward upon downward movement of said lower spring arm by said lever arm thereby to quickly move said reciprocal member to said one position, means to swing said lever arm free end toward said rod, and means to overcome said last-named means so that the tension of said upper spring arm will move said reciprocal member to said other position.

5. In a control device, a reciprocal member biased to one position and having a stem, a supporting rod transverse to said stem, a U-shaped leaf spring bent about said rod and having upper and lower arms, a supporting member for the free end of said upper arm, said lower arm extending into operative engagement with said stem for moving said reciprocal member to another position, a lever arm extending downward from and secured to said lower spring arm adjacent said rod, said lever arm having its free end swingable longitudinally of said spring and toward said rod to tension said upper spring arm and to flex said lower spring arm downward for movement of said reciprocal member toward said one position, an armature on said stem, a magnet cooperable with said armature and tending to hold said reciprocal member in said one position, said magnet flexing said lower spring arm downward upon downward movement of said lower spring arm by said lever arm thereby to quickly move said reciprocal member to said other position, said lever arm free end having a cam follower, a lever having an end face and having a cam face leading to said end face, said faces being sequentially engageable with said follower, means to rotate said lever to press said cam face against said follower to swing said lever arm free end toward said rod and to continue the rotation of said lever to move said cam face off said follower and said end face into abutting engagement with said follower, and means to overcome said last-named means so that the tension of said

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upper spring arm will move said reciprocal member to said other position.

6. In a control device, a reciprocal member biased in one direction and having a stem, spaced abutment members, a leaf spring supported by said members and having a spring portion extending therebetween and an end portion engaging said stem, an arm secured to said end portion and rockable to tension said spring portion and move said end portion, a lever having end engagement with said arm to hold said arm in a rocked position and said spring portion under tension, said lever having an edge portion engageable with said arm to control the movement of said spring end portion by the tensioned spring portion, a spring acting on said lever to hold said lever in said end engagement with said arm, and a power element operable to move said lever against the force of said last-named spring and into said edge portion engagement with said arm so that said spring end portion moves said reciprocal member.

7. In a control device, a reciprocal member normally biased in one direction and having a stem, a shaft extending transverse to said stem, a lever pivoted on said shaft, a stop member engaged by said lever, a spring tending to hold said lever against said stop member, a power element acting on said lever and operable to overcome said spring and move said lever, a leaf spring having a fixed end portion and a free end portion, means supporting said fixed end portion against movement relative to said reciprocal member, said free end portion being tensioned against said stem to move said reciprocal member in the opposite direction, and an arm rigidly secured to the free end portion of said leaf spring and engaging said lever in a rocked position to hold said leaf spring under tension and to prevent release of force by said leaf spring, movement of said lever by said power element permitting said arm to move to release the tensioned force of said leaf spring and thereby causing said leaf spring to move said reciprocal member.

8. A control device comprising a housing having an end wall, a reciprocal member extending from said housing, a shaft supported in said housing and extending transverse to said member, a lever pivoted on said shaft and having one end extending toward said wall, a bellows type heat motor having a casing extending through and supported in said wall, said motor having a thrust member engaging said lever, a supporting rod secured to said wall within said housing, a leaf spring bent around said rod and having one end engaging and operable to move said reciprocal member, a supporting member for the other end of said spring, an arm secured to said spring and having its free end movable toward said wall to tension said spring, a cam follower extending laterally from the free end of said arm, said lever having a cam portion engageable with said follower to rock said arm, and a spring having one end secured to said wall and acting at its other end on said lever in opposition to said thrust member.

9. In a control device, a longitudinally movable member, guide means for said member, means biasing said member in one direction, a leaf spring engaging said member and operable to hold the same against movement in said one direction, means supporting one portion of said

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spring against movement relative to said guide means, an arm rigidly secured to said spring and operable upon rocking movement to flex said spring in said one direction, said spring being operable upon release of its flexing force to move said member in the opposite direction, a lever engageable with and operable to rock said arm and operable to hold said spring against release of its flexing force in said opposite direction, said lever being operable to have movement relative to said arm, and said lever being operable upon said relative movement to permit movement of said arm to release the flexing force of said spring to move said member in the opposite direction.

10. In a control device, a longitudinally movable member, guide means for said member, means biasing said member in one direction, a leaf spring engaging said member and operable to hold the same against movement in said one direction, means supporting one portion of said spring against movement relative to said guide means, an arm rigidly secured to said spring and having a lateral flange, said arm being operable upon rocking movement to flex said spring in said one direction, said spring being operable upon release of its flexing force to move said member in the opposite direction, a lever having a cam portion engageable with said flange and operable to rock said arm and operable to hold said spring against release of its flexing force in said opposite direction, said lever being operable to have movement relative to said arm, and said lever being operable upon said relative movement to permit movement of said arm to release the flexing force of said spring to move said member in the opposite direction.

11. In a control device, a longitudinally movable member having a range of movement, means to move said member through one end portion of said range, a hairpin shaped leaf spring having one end portion fixed and the other end portion free and having the reverse bend portion pivotally fixed, said free end portion being engageable with said member, said spring being the sole means for moving said member through another portion of its range of movement, an arm rigidly secured to and extending from said spring, and means laterally engageable with said arm to rock the same to flex said spring.

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