Nov. 22, 1949 W. HUNGATE 2,488,596

SNAP ACTING MECHANISM

Filed April 12, 1946 3 Sheets-Sheet 1

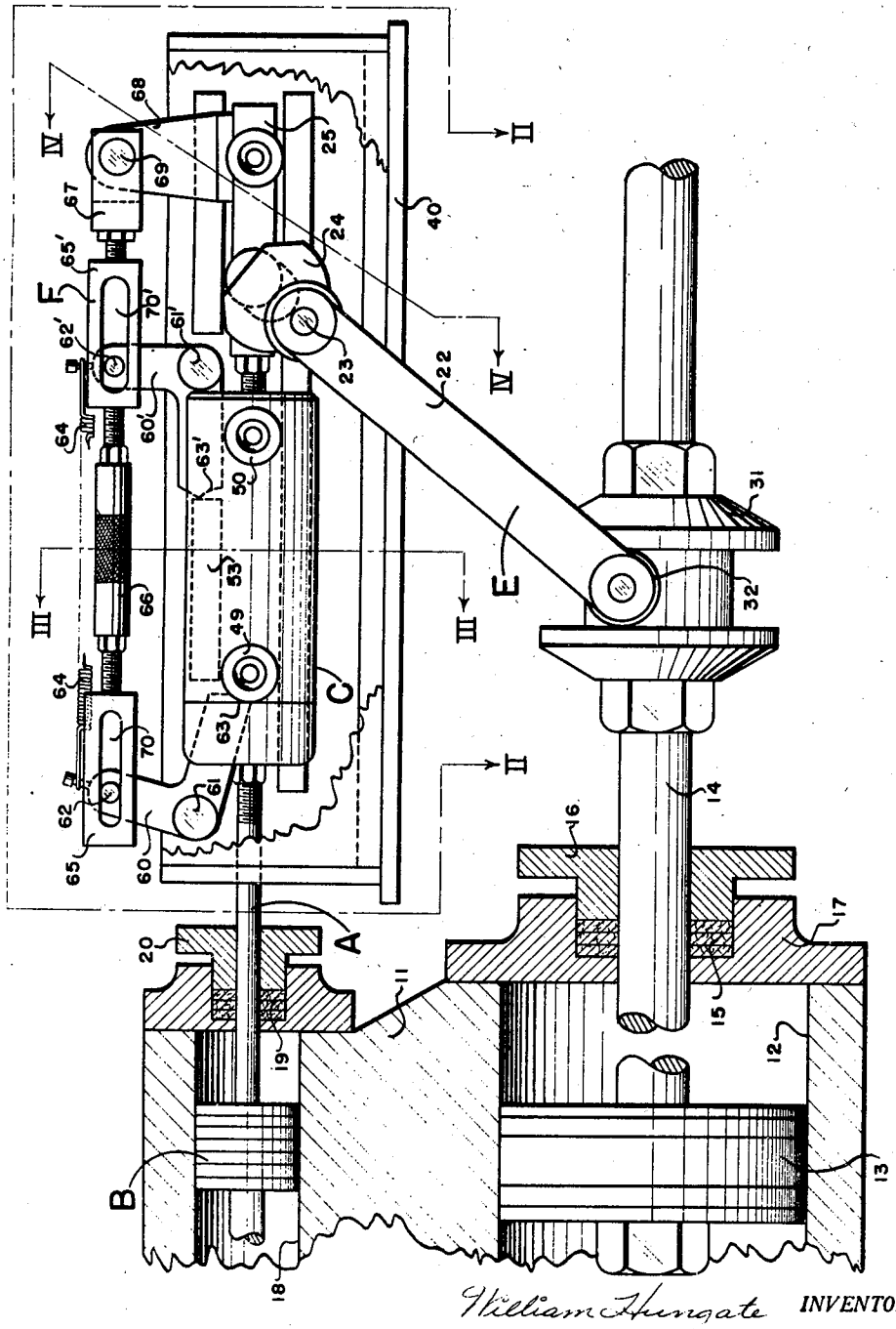


FIG. 1.

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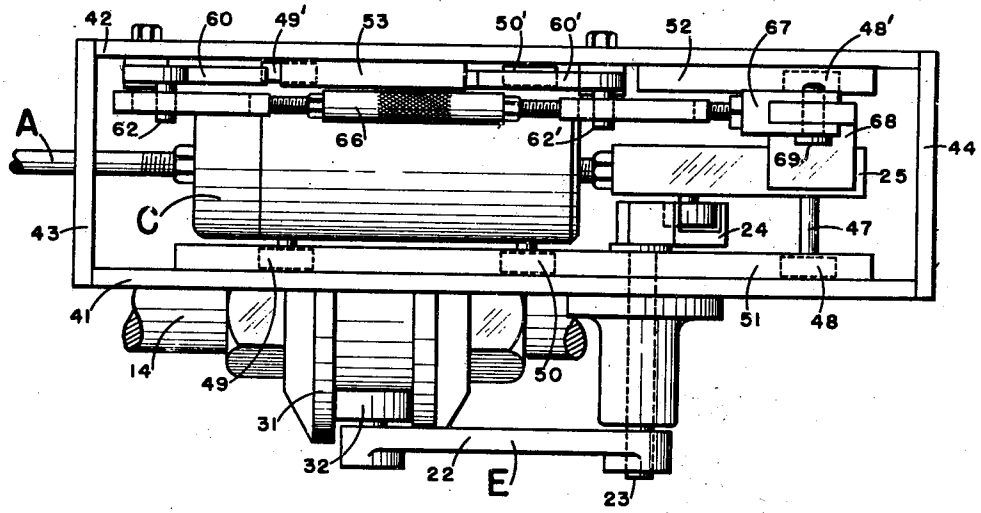


FIG. 2.

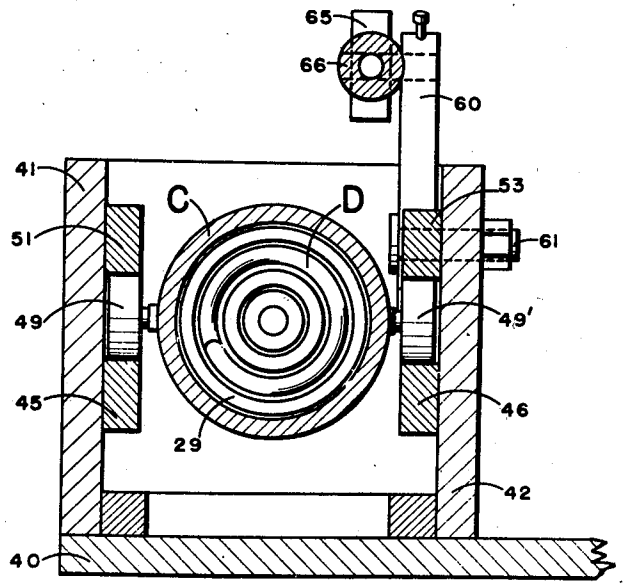


FIG. 3.

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SNAP ACTING MECHANISM

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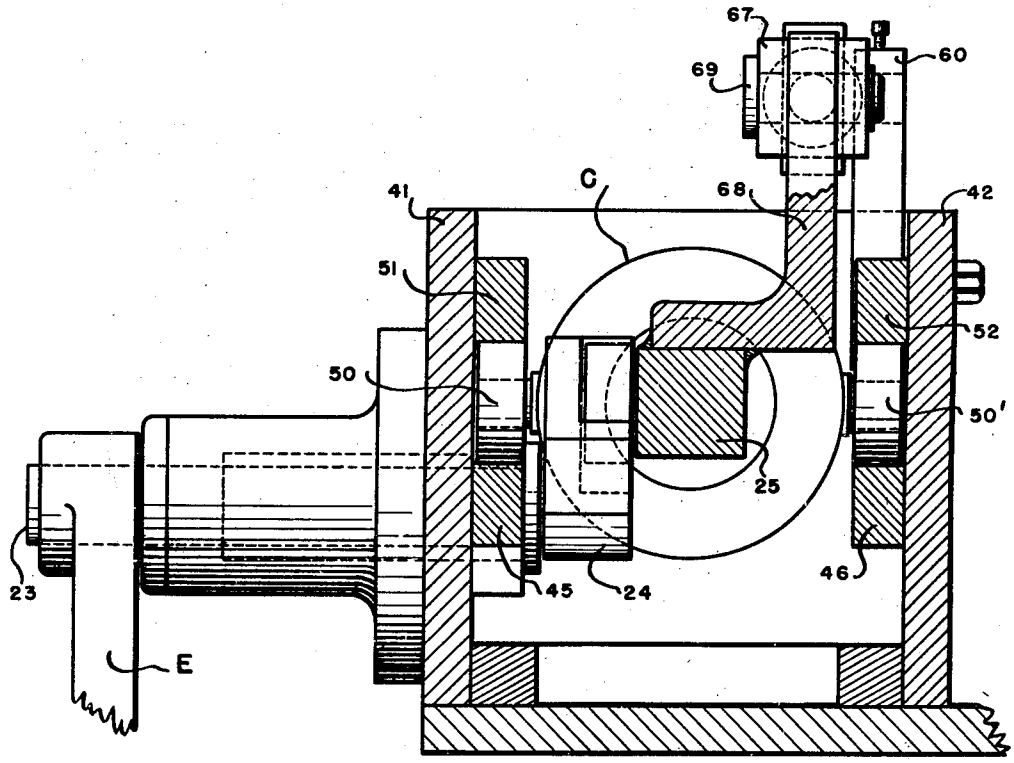


FIG. 4.

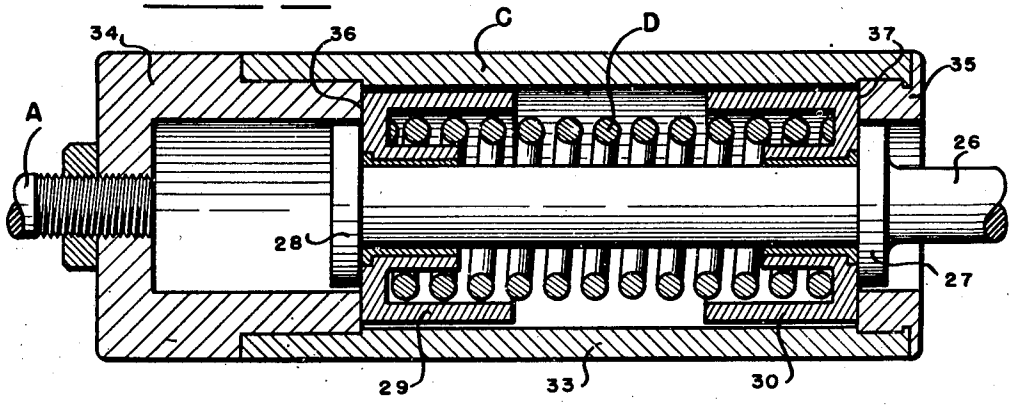


FIG. 5.

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UNITED STATES PATENT OFFICE

2,488,596

SNAP ACTING MECHANISM

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Application April 12, 1946, Serial No. 661,829

6 Claims. (Cl. 74—100)

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The present invention is directed to a snap acting mechanism particularly adapted for operating the valves of a steam engine.

The device of the present invention is a mechanism adapted to be applied to a steam engine provided with a piston operating in a cylinder, a valve rod, and valves carried by the valve rod for controlling the entry of steam into the cylinder. The mechanism has a spring for storing energy, a linkage for supplying energy to the spring by the piston, a holding means for preventing the dissipation of the energy during the major portion of the stroke of the piston, and a release mechanism for suddenly releasing the energy at the end of the stroke of the piston to change the position of the steam valve which controls the direction of flow of steam into the piston cylinder. In other words, the device may be described as a snap-acting valve mechanism which is operated by the reciprocating motion of a piston and operates the valve controlling the direction of flow of steam into the cylinder in which the piston reciprocates.

Other objects and advantages of the present invention may be seen from the following description taken with the drawing in which

Fig. 1 is an elevation, partly in section, showing an embodiment of the present invention;

Fig. 2 is a view along line II—II of Fig. 1;

Fig. 3 is a view along line III—III of Fig. 1;

Fig. 4 is a view along line IV—IV of Fig. 1; and

Fig. 5 is a cross section view of a portion of the assembly.

The principal elements of the mechanism of the present invention are designated by letters and the remaining portions are designated by figures.

A valve rod A is attached to the valve B whereby longitudinal movement of the valve stem changes the setting of valve B. A spring case C is attached to the other end of the valve stem and arranged to drive the valve stem from one position to the other to change the setting of valve B. Mounted within the spring case is a spring D which, in turn, is arranged for driving case C. The device is further provided with a spring loading unit E and a holding and release unit F.

Considering now the drawing in detail, the body 11 of a steam pump defines a steam cylinder having an inner wall 12 in which piston 13 is arranged to reciprocate. Secured to the piston is piston rod 14 which passes through a suitable packing means comprising a packing gland 15

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and a follower 16 mounted on the cylinder head 17 of the pump. The valve rod A, secured to valve member B, passes through the head of the steam pump through a suitable packing means comprising packing gland 19 and follower 20. It will be understood that the steam pump is a conventional double acting pump and defines valve passages for allowing steam to enter and be removed from the cylinder with these valve passages controlled by a valve. The valve passages defined by body 11 are not shown in detail, a portion merely being shown as defining the inner wall 18 of a cylindrical passage in which valve B is arranged to reciprocate; similarly, the valves controlling the inlet and exhaust passages of the pump are not shown in detail but rather are illustrated by the showing of a single valve B.

The spring loading mechanism E includes a lever 22 having its upper end secured to shaft 23, a yoke 24 mounted on shaft 23, a tail bar 25, a plunger 26 in the form of a rod having spaced shoulders 27 and 28 mounted thereon and spring followers 29 and 30. This mechanism is arranged to be operated by the reciprocation of piston rod 14, the piston rod being provided with a cross head 31 defining a laterally extending slot arranged to receive a roller 32 which is secured to the lower end of lever 22; it will be obvious that as the piston rod 14 reciprocates lever arm 22 is rotated about shaft 23 and this causes rocking of the yoke which, in turn, produces reciprocating motion in tail bar 25 and plunger 26.

The spring case C consists of a tubular member 33, a head member 34 secured both to tubular member 33 and to valve stem A, and a head member 35. Head member 34 defines an axial passage of such a diameter as to allow shoulder 28 of plunger 26 to be slidable therein while at the same time defining a shoulder 36 which restrains follower 29. Head 35 similarly defines an axial opening which allows shoulder 27 of plunger 26 to be freely slidable therein while at the same time defining a shoulder 37 to restrain follower 30. It will be seen from this construction of spring case C that when the spring case is held against longitudinal movement, a movement of plunger 26 to the left will cause shoulder 27 to move follower 30 to the left, thereby compressing the spring and, similarly, the movement of plunger 26 to the right will cause shoulder 28 to move to the right which, in turn, moves follower 29 and compresses spring D.

A frame comprises a base plate 40, side plates 41 and 42 and end plates 43 and 44. The base

plate may conveniently be secured, by means not shown, to the frame of the steam engine. Attached to side plate 41 is a lower horizontally extending rail 45 and attached to side plate 42 is a similar lower rail 46 parallel with rail 45. The rails 45 and 46 will be seen to define a track for supporting the tail bar 25 and spring case C. Secured to tail bar 25 is a laterally extending rod 47 which serves as a mounting means for rollers 48 and 48'. Rollers 49 and 50 are secured to one side of spring case C and arranged to rest on rail 45 and, in like manner, rollers 49' and 50' are secured to the other side of the spring case and arranged to rest on rail 46. A rail 51 is secured to side plate 41 above rail 45 and parallel thereto, the two rails 45 and 51 serving as a guide way for rollers 48, 49 and 50. Spaced rails 52 and 53 are secured to side plate 42 and spaced above the rail 46. Spaced rails 52 and 53 cooperate with the lever arms of the holding and release mechanism hereinafter described to form an upper guide surface and, together with lower rail 46, act as guide means for rollers 48', 49' and 50'. The holding and release unit F includes a pair of holding arms 60 and 60' with the arms pivoted to side plate 42 on pins 61 and 61', respectively. Arm 60 is ell-shaped with one portion projecting upwardly and provided with a passage for receiving a transversely extending pin 62, and one portion projecting horizontally and defining an arcuate cam surface 63. Arm 60 is pivoted on pin 61 and is arranged to assume a first position with that portion defining cam surface 63 horizontal and to pivot on pin 61 clockwise to a second position in which that portion defining cam surface 63 tilts downwardly. Arm 60' is ell-shaped with one portion projecting upwardly and provided with a passage for receiving a transversely extending pin 62' and one portion projecting horizontally and defining an arcuate cam surface 63'. Arm 60' is pivoted on pin 61' and is arranged to assume a first position with that portion defining cam surface 63' horizontal and to pivot on pin 61' counterclockwise to a second position in which that portion defining cam surface 63' tilts downwardly. A spring 64 has one end secured to the upper end of the upwardly projecting portion of arm 60 and its other end secured to the upper end of the upwardly projecting portion of arm 60', thereby exerting a bias on each arm to move it from its first position to its second position. When the arm 60 is in its first position the lower surface of the lower portion thereof is parallel with rail 53 and cooperates with this rail to form a track limiting the upward movement of roller 49' and similarly when arm 60' is in its first position its lower portion cooperates with rail 53 to limit the upward movement of roller 50'.

The holding and release mechanism F, in addition to arms 60, 60' and spring 64 includes slotted link 65, slotted link 65', a turn buckle 66 connecting the two slotted links, a clevis 67 attached to link 65' and a lug 68 secured to tail bar 25 and attached to clevis 67 with a pin 69 whereby the longitudinal movement of the tail bar is transmitted to the clevis. Pin 62 extends transversely from the upper end of lever arm 60 through slot 70 of link 65 and, similarly, pin 62' extends transversely from the upper end of arm 60' through slot 70' of link 65'.

The holding and release mechanism F is arranged so that as the piston rod 14 moves to the right and causes tail bar 25 and plunger 26 to move to the left, the spring case C is locked against movement to the left during substantially the entire stroke of the piston by arm 60 which is in its second position with surface 63 in contact with roller 49' but as the piston rod approaches the end of its stroke arm 60 is moved from its second to its first position, whereby cam surface 63 is raised upwardly out of contact with roller 49' and releases the spring case for sudden movement to the left, thereby driving valve B and reversing the setting of the valves covering the inlet and exhaust ports of the pump and causing piston rod 14 to begin the portion of the stroke moving to the left. As the spring case C moves to the left the roller 50' moves to the left of cam surface 63' of lever arm 60', thereby allowing the lever arm to move from its first to its second position whereby cam surface 63 may contact roller 50' and lock case C against movement to the right as piston rod 14 begins its return stroke to the left. As piston rod 14 moves to the left it causes tail bar 25 and plunger 26 to move to the right, thereby compressing spring D; and as the piston rod approaches the end of the stroke lever arm 60' is moved from its second position to its first position to move surface 65 upwardly out of contact with roller 50', thereby releasing spring case C for sudden movement to the right to drive valve rod A and piston B to the right. This movement of case C also causes roller 49' to move beyond surface 63 of lever arm 60 which, in turn, allows lever arm 60 to move from its first to its second position to bring surface 63 downward, whereby lever arm 60 assumes the position as shown in the drawing. The movement of the spring case to the right reverses the direction of flow of steam in the engine and places it in the position for repeating the cycle just described.

Slotted links 65 and 65' are of such proportions and of such spacing that when the piston rod 14 is moved to the right the end of slot 70 will contact with pin 62 as the piston approaches the end of the stroke, thereby tilting lever arm 60 to force surface 63 upwardly and release roller 49' for movement to the left. Similarly, slotted link 65' is of such dimensions that when the piston rod is moved to the left the end of slot 70' will contact pin 62' as the piston approaches the end of the stroke, thereby tilting lever arm 60' to force surface 63' upwardly and release roller 50' for movement to the right under the influence of energy stored in spring D.

From the above discussion it will be evident that the valve operating mechanism of the present application is provided with a means for storing up energy during the major portion of the stroke of a power piston and for suddenly releasing the energy as the piston approaches the end of each stroke, whereby the released energy is utilized to drive the valve controlling the steam inlet and exhaust ports of the cylinder in which the power piston reciprocates.

The nature and objects of the present invention having been fully described and illustrated, what is desired to be claimed as new and useful and secured by Letters Patent is:

1. A device adapted for activating the valve rod of a steam engine having a piston and piston rod and valves carried by a valve rod controlling the inlet and exhaust ports of the engine, comprising, in combination, a track adapted to be mounted parallel to the axis of the valve rod, a case, means mounted on the case arranged to cooperate with the track for limiting the movement of the case to a direction parallel to the axis of the

track, a spring mounted in said case to transmit energy stored in said spring to said case in a direction parallel to the axis of the track, means adapted to be mechanically connected to the piston rod for supplying energy to said spring, releasable means for locking the case in a fixed position during the major portion of the stroke of the piston rod and means for releasing said locking means at a predetermined point near the end of the stroke of the piston rod.

2. A device adapted for activating the valve rod of a steam engine having a piston and piston rod and valves carried by a valve rod controlling the inlet and exhaust ports of the engine, comprising, in combination a track adapted to be mounted parallel to the axis of the valve rod, a case, means mounted on the case arranged to cooperate with the track for limiting the movement of the case to a direction parallel to the axis of the track, a spring mounted in the case to transmit energy stored in said spring to said case in a direction parallel to the axis of the track, an arm adapted to be pivoted to a base and to be mechanically connected to the piston rod for oscillating arcuate movement upon reciprocation of the piston rod, a linkage mechanically connecting the arm with the spring for transmitting energy from the arm to the spring, releasable means for locking the case in a fixed position during the major portion of the stroke of the piston rod and means for releasing said locking means at a predetermined point near the end of the stroke of the piston rod.

3. A device in accordance with claim 2 in which the releasable holding means includes a pivoted lever arranged to assume a first position locking the case against movement and to assume a second position releasing the case, and the releasing means includes a body mechanically linked to the arm for oscillation therewith.

4. A device in accordance with claim 2 in which the releasable holding means includes a pivoted lever arranged to assume a first position locking the case against movement and to assume a second position releasing the case, a pin attached to one end of the lever arm, and the releasing means includes a slotted link mechanically connected to the arm for oscillation therewith, with the longitudinal axis of the slot parallel with the direction of movement of the link and the slot engaging with the pin.

5. A device in accordance with claim 2 in which the releasable holding means includes a first and a second pivoted lever with each lever arranged to assume a first position locking the case against movement and to assume a second position releasing the case, and a pin attached to one end of the first lever, a pin attached to one end of the second lever, and the releasing means includes a pair of spaced slotted links mechanically connected to the arm for oscillation therewith, with the longitudinal axes of the slots parallel with the direction of movement of the pair of links, and with each of said slots separately engaging with a pin.

6. A device for operating a valve rod of a direct acting steam engine comprising, in combination, a frame, a plunger member adapted to be secured to the valve rod and provided with spaced circular shoulders, followers slidably mounted on the plunger member on the portion between said shoulders, a spring member mounted on the plunger member with one end resting against one of the followers and the other end resting against another follower, a cylinder member mounted on the plunger member and defining spaced shoulders, one of said shoulders having its inner end contacting one of said followers radially beyond the circular shoulders of the plunger member and the other shoulder contacting the other follower adjacent the other shoulder of said plunger, spaced first and second cam rollers mounted on the exterior of said cylinder, a first bent lever arm member, a pin attaching said first lever member to the frame to allow the lever to be pivoted in a first position whereby an end contacts said first cam roller and a second position whereby the lever arm is above said cam roller, a second lever arm, a pin attaching the second lever arm to said frame and arranged so that an end of the lever arm is in contact with said second cam roller when in a first position and is clear of the second cam roller when in a second position, an elongated member arranged parallel with the axis of the cylinder body and defining first and second spaced elongated slots, members securing the elongated member to said plunger member for longitudinal movement therewith, a laterally extending pin carried by the end of the first lever member and arranged in said first slot, a second laterally extending pin carried by the upward extending member of said second lever arm and sliding in the second elongated slot, a biasing means biasing the upward extending ends of the first and second lever arms toward each other, said slots being spaced whereby said first slot tilts the first lever arm upwardly out of contact with the first cam roller when the plunger reaches the limit of its movement in one direction and said second slot tilts the second lever arm upwardly out of contact with the second cam roller as the plunger reaches its extreme limit of motion in the opposite direction.

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