Aug. 25, 1931. R. C. ROEBLING 1,820,033

MECHANICAL MOVEMENT

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Fig. 1.

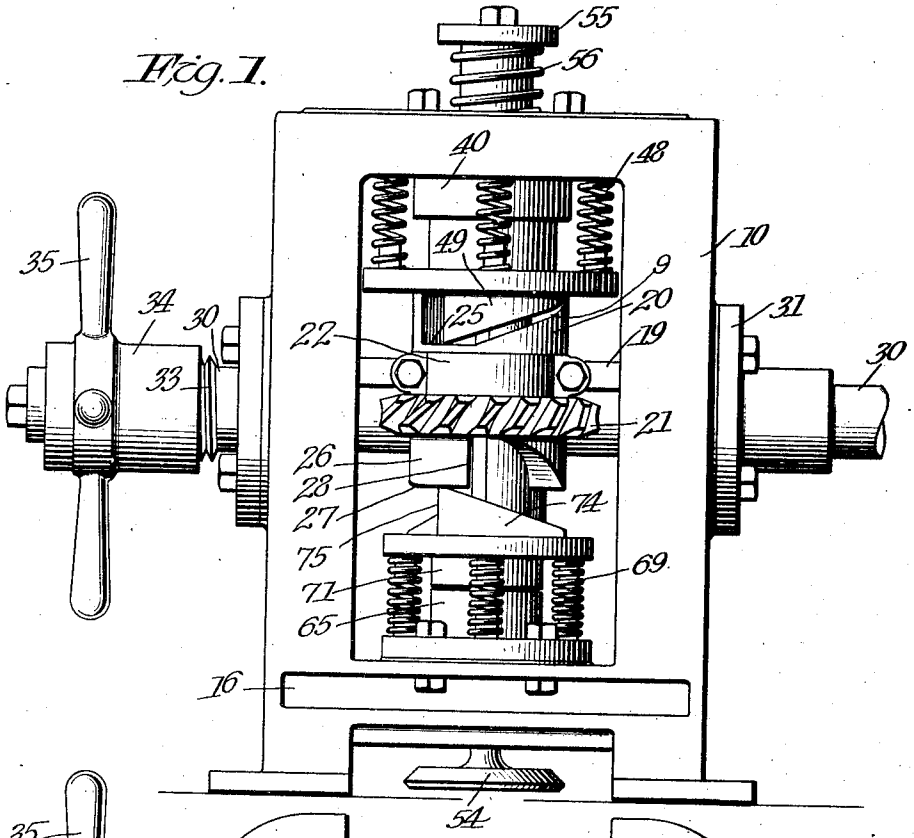
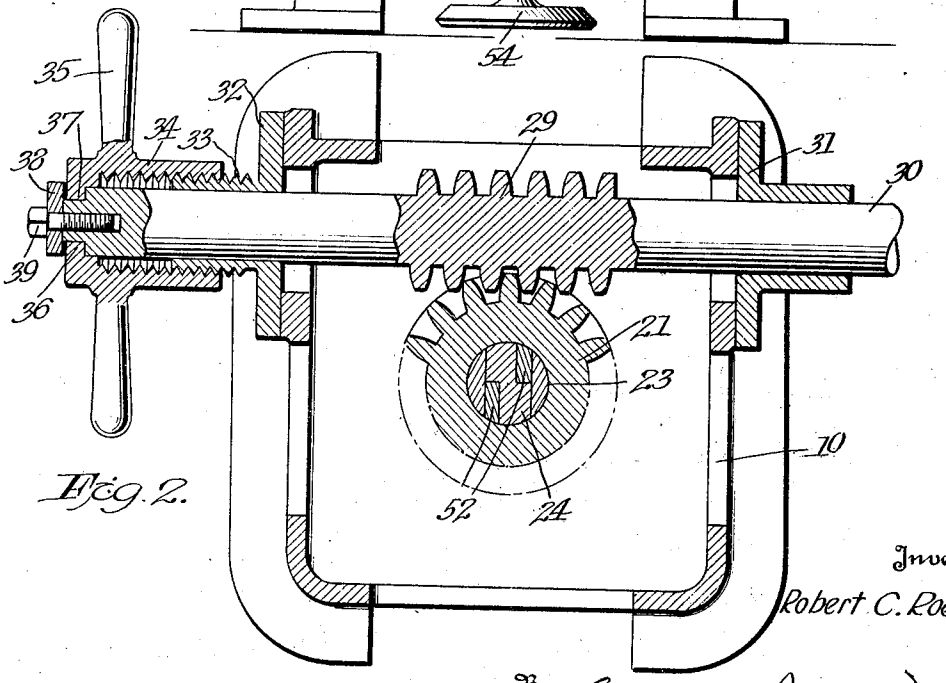


Fig. 2.



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MECHANICAL MOVEMENT

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Fig. 3.

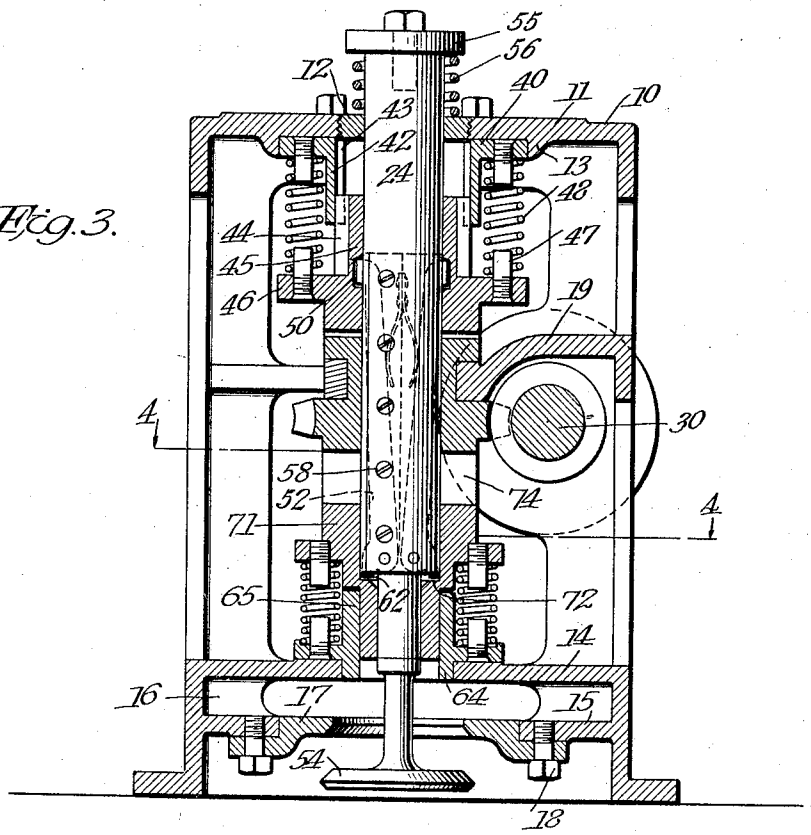
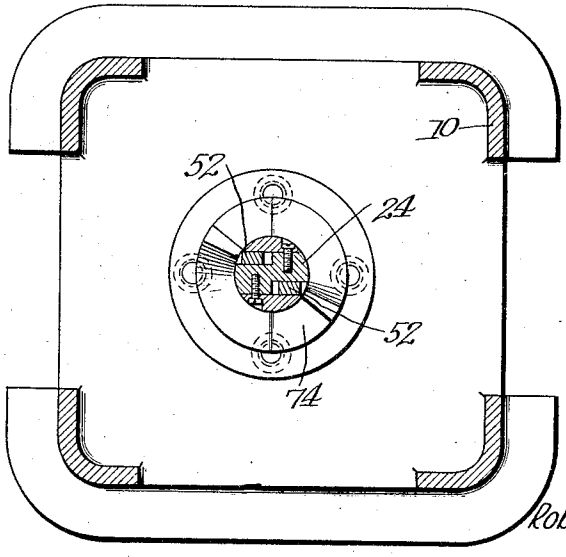


Fig. 4.



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MECHANICAL MOVEMENT

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Fig. 5.

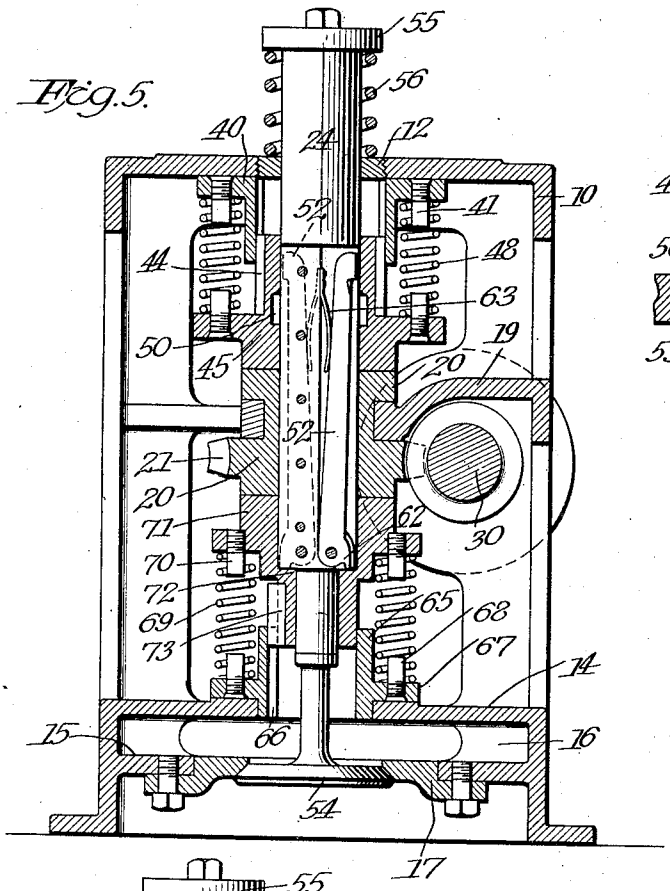
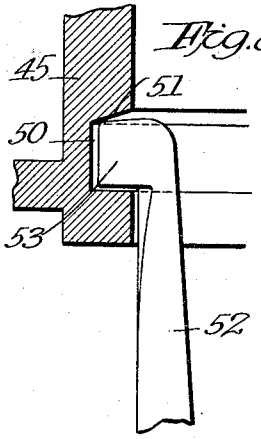


Fig. 8.



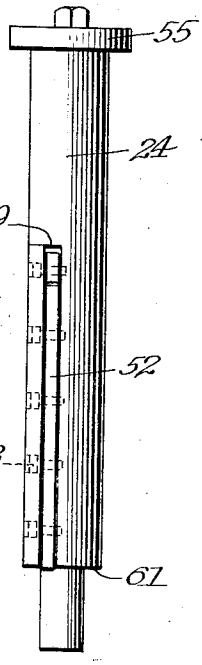


Fig. 6.

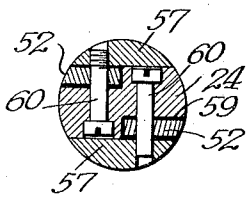


Fig. 7.

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Patented Aug. 25, 1931 1,820,033

UNITED STATES PATENT OFFICE

ROBERT C. ROEBLING, OF TRENTON, NEW JERSEY

MECHANICAL MOVEMENT

Application filed September 28, 1928. Serial No. 309,022.

This invention relates to new and useful improvements in mechanical movements, and more particularly to means for converting rotary into reciprocating movement.

An important object of the invention is to provide such means to impart speed, approaching the instantaneous, to the reciprocating movements of the reciprocated part.

Another important object of the invention is to provide the reciprocating member with automatically operable means alternately coupling the same with driving forces for alternately moving the reciprocating member in opposite directions.

A still further object of the invention is to provide timing means for minutely varying the relative positions of the operating cams to slightly advance or retard the time at which the reciprocations are effected.

Other objects and advantages of the invention will become apparent during the course of the following description.

In the accompanying drawings forming a part of the description, and wherein like numerals are employed to designate like parts throughout the several views,

Figure 1 is a side elevation of the apparatus involving my invention.

Figure 2 is a horizontal transverse section of the same taken just above the drive shaft.

Figure 3 is a vertical section through the apparatus shown in Figure 1, taken at right angles thereto.

Figure 4 is a horizontal transverse section of the same taken on the line 4—4 of Figure 3.

Figure 5 is a vertical section similar to Figure 3 showing the parts in a different position.

Figure 6 is a side elevation of the reciprocating member.

Figure 7 is a transverse section of the same, and

Figure 8 is an enlarged transverse section of a portion of the upper driving head showing the detailed construction of the interlocking means between such head and the reciprocating member.

Referring now more specifically to the drawings, wherein for the purpose of illustration, one example of the invention is shown, the numeral 10 designates any kind of supporting frame, here shown as a stand having a top 11 provided with a central threaded opening for the reception of a threaded bearing collar 12 and having formed on its underside, a concentric annular ridge 13 for a purpose which will be hereinafter described.

The bottom of this stand comprises a pair of vertically spaced horizontal plates 14 and 15 defining therebetween what may be referred to as a manifold 16 as hereinafter explained. The lowermost plate 15 is provided with a central opening for the reception of the valve seat 17 bolted to the bottom plate by means of bolts 18 as shown.

Between the top and bottom plates of the stand, there is provided a bearing web 19 formed integral with the stand for the support of an actuating member, here shown as a double cam 20 formed integral with a worm wheel 21, the upper cam forming a shoulder for support upon the bearing web 19. A removable bearing plate 22 is bolted to the bearing web to constitute a part of the bearing for the cam 20. This double cam and worm wheel is provided with an axially extending opening 23, as shown in Figure 2, for the free sliding reception of a reciprocating member indicated by the numeral 24, which will be more fully described hereinafter.

A pair of diametrically disposed cam surfaces 9 are provided on the upper end of the double cam member 20 with plain flat horizontal surfaces 25 separating the two cam surfaces, it being noted that the cams 9 terminate at their high points with abrupt shoulders for a purpose which will be presently described.

The bottom of the double cam member is also equipped with a pair of diametrically arranged depending cams 26, which instead of having a plain flat surface, such as 25, separating the same, have such plain flat horizontal surfaces on the high points of the two cams as designated by the numeral 27, it also being noted that the high points of the lower cams terminate in abrupt vertical

shoulders 28. The cams 9 and 26 all taper off in a counter-clockwise direction, as illustrated, and the actual camming surfaces of these cams may be equipped with oil grooves or openings, if desired.

The worm wheel 21, as best seen in Figure 2, is adapted to mesh with a worm 29 formed upon a power shaft 30 extending horizontally and transversely through the stand 10 to be slidably and rotatably mounted in journals 31 and 32 bolted to opposite sides of the stand. Means are provided for axially shifting the shaft 30, in order to turn the double cam a small fraction of a revolution and one of the many ways of accomplishing this, is to form the journal or bearing 32 with a tubular externally threaded outwardly extending sleeve portion 33, upon which is threadedly mounted a nut 34 having suitable operating handles 35, and an annular shoulder 36 at its outer end for reception in an annular groove provided in the end of the shaft 30 by reducing the diameter of the shaft, as at 37, and bolting a collar 38 by means of a bolt 39 to the end of this shaft so as to cause the shaft to be moved longitudinally by rotating the nut 34 in either direction.

By this means, a timing mechanism is provided which will minutely vary the relative positions of the double cam 20 with respect to cooperating cam surfaces to be hereinafter described.

Bolted within the annular ridge 13 of the top plate 11 is a spring retainer and guide 40 having suitably secured in and depending from its horizontal flange, four spring retaining pins 41 spaced equi-distantly thereabout. This plate 40 is provided with a depending boss or sleeve-like portion 42, which is arranged concentric to the bearing 12, and is equipped at diametrically opposite points on its interior with longitudinally extending grooves or guideways 43.

Operating in these guideways are keys 44 secured to what may be termed an upper driving head 45 which is mounted upon the reciprocating member 24, and is slidable relative to the latter at times, while at other times it is interlocked to move with the same. This upper driving head is equipped with an outwardly projecting annular flange 46 which has secured thereto a plurality of upstanding pins 47 in alignment with the pins 41 in order that the opposite ends of four coil springs 48 may be mounted upon the four pairs of pins 41 and 47 to normally urge the upper driving head 45 in a downwardly direction. Depending from this annular flange 46 are a pair of diametrically disposed cams 49 to cooperate with the upper cams 9 of the worm wheel, and for this purpose are provided with abrupt vertical shoulders, and are tapered off in a clockwise direction, so that rotation of the double cam 21 in a counter-clockwise direction, will cause the cams 9 and 49 to cooperate in elevating the upper drive head 45 and compressing the springs 48 to enable the abrupt shoulders of the cams 49 to drop off of the corresponding shoulders of the cams 9 at one stage of the rotation of the worm, so as to permit the springs 40 to swiftly move the upper driving head downwardly to be limited by the high points of the cams 49 engaging the horizontal flat portions 25 of the cams 9.

In order to interlock the member 24 and head 45 and to cause movement of the reciprocating member 24 in one direction, under the influence of the spring urged head 45, the latter is provided with an interior annular groove 50, as shown in detail in Fig. 8, it being particularly noted that the upper side wall 51 of this groove is bevelled upwardly to cooperate with the upper ends of spring pressed detents or pawls 52 in releasing the outwardly projecting noses 53 of these pawls from the upper driving member 45, at certain intervals in a manner which will be hereinafter described, so as to permit the reciprocating member 24 to slide upwardly through the driving member at certain periods of operation of the device.

As one example of the application of the herein disclosed mechanical movement, I have elected to illustrate the reciprocating member 24 as a valve stem having a valve head 54 detachably connected with its lower end, and adapted to seat upon the valve seat 17. As stated hereinbefore, this reciprocating member 24 is slidably mounted in the double cam 20, and its upper end slidably projects through the bearing collar 12 to extend thereabove, where it is equipped with a removable cap plate 55 forming an abutment for one end of a coil spring 56 surrounding the upper end of the valve stem, and having its other end abutting against the bearing collar 12 to normally exert an upward lift upon the reciprocating member.

As best shown in Figs. 6 and 7, opposite faces of the reciprocating member 24 are provided with stepped formations which cooperate, with movable segmental plates 57 secured to the stepped sides of the reciprocating member by means of machine screws 58 having their heads countersunk, in providing longitudinally extending pockets or grooves 59 on opposite sides of the reciprocating member for the reception of the elongated pawls 52. These two pawls are pivoted to the reciprocating member by means of machine screws 60, the heads of which are countersunk into the reciprocating member and covered by the segmental plates 57 as best seen in Fig. 7.

At the pivotal connection of the pawls, the reciprocating member is reduced in diameter to provide the same with an annular shoulder

61, below which the lower trigger-shaped ends 62 of the pawls project, due to the upper ends of the pawls being normally urged outwardly of the periphery of the reciprocating member, by means of flat springs 63 secured to the bottoms of the grooves 59, as best seen in Fig. 5.

As best seen in Figs. 3 and 5, the bottom plate 14 of the stand is equipped with a central opening for the reception of a tubular extension 64 of a spring retainer and guide plate 65, which is of sleeve-like configuration with its bore in axial alignment with the bore of the upper guide sleeve 40, and is likewise equipped with diametrically arranged vertical guide grooves 66. This guide sleeve is equipped with an outwardly extending annular flange 67, on which are four upwardly projecting spring retainer pins 68 secured in the flange in any suitable manner, and adapted to form centering and retaining studs for the lower ends of four coil springs 69 arranged equi-distantly around the flange 67.

The upper ends of these coil springs 69 encircle four depending pins suitably secured in the outwardly extending annular flange of a lower driving head 71. This driving head 71 is mounted upon the reciprocating member 24, and for this purpose is equipped with an opening fitting the largest diameter of the reciprocating member 24 and being reduced at its lower end to slidably receive the reduced portion of the reciprocating member and to provide an annular shoulder 72. The lower end of the driving member 71 is reduced to slidably fit within the guide sleeve 65 and is equipped with diametrically arranged keys 73 to slidably fit within the grooves 66 and prevent the lower driving head from rotating in the same manner that the keys 44 of the upper driving head prevent it from rotating within its guide plate 40.

The upper surface of the lower driving head 71 is provided with a pair of diametrically disposed upstanding cams 74 which taper off in a counter-clockwise direction and terminate in abrupt shoulders 75 as best seen in Figure 1.

The operation of the mechanism will be more clearly understood by first referring to Figure 5. In this figure it will be noted that the noses 53 of the pawls 52 are disengaged from the annular recess 50 in the upper driving head 45 by reason of the cams being positioned to permit the expansion or full relaxation of the two sets of springs 48 and 69 while the spring 56 serves in retaining the reciprocating member 24 in its uppermost position with the valve 54 in closed position. In this position of the mechanism, the high points of the cams 49 and 74 of the upper and lower driving heads respectively, are in engagement with the low points of the double cam 22. Upon rotation of the power shaft 30, the worm wheel 21 is rotated in a clockwise direction, causing the double cam 20 to move the upper and lower drive heads in opposite directions simultaneously to compress both sets of springs 48 and 69. During this period of operation, it will be obvious that the upper driving head 45 moves upwardly upon the reciprocating member 24, until its annular recess 50 is disposed opposite the noses of the pawls 52, at which time the springs 63 will snap the upper ends of the pawls outwardly, so as to dispose their noses within the annular recess 50 and create an interlocking or driving connection between the upper head 45 and the reciprocating member. At this time, the high points of the cam surfaces 9 and 49 will be engaged and in such position that further clockwise rotation of the double cam 20 will permit the cams 49 of the upper driving head to drop from the high points of the cam surfaces 9, under the influence of the powerful springs 48. Due to the fact that the upper driving head has been previously interlocked with the reciprocating member, the latter will be rapidly driven downwardly together with this upper driving head, so that the parts will assume the positions illustrated in Figure 3. This will obviously cause the valve 54 to be rapidly opened and the spring 56 overcome and tensioned by the expansion of the springs 48.

At this stage of the operation, it will be noted from Figure 3, that the lower trigger ends 62 of the pawls 52 will be arranged slightly above the annular shoulder 72, formed in the lower driving head 71 and the horizontal flat portions 27 of the double cam will be engaged with the high points of the cams 74 of the lower driving head, thereby maintaining the set of springs 69 under compression. Upon further rotation of the double cam in a clockwise direction, the abrupt shoulders 28 of the double cam will move to a position above the abrupt shoulders 75 of the lower driving head and release the set of coil springs 69 to rapidly move the lower driving head upwardly so that its annular shoulder 72 will engage the trigger ends 62 of the pawls 52 to swing the noses thereof inwardly of the reciprocating member, so that they will automatically become disengaged from the upper driving head 45; this inward movement of the pawls 52 being augmented by the simultaneous upward movement of the reciprocating member 24 under the influence of the expansion of the springs 69, thereby causing the noses 53 of the pawls to ride up the inclined surfaces 51 of the annular groove 50 to become totally disengaged therefrom and permit of the reciprocating member being moved upwardly under the influence of the spring pressed lower driving head 71. Obviously, this up-

ward movement of the reciprocating member 24 causes the valve 54 to rapidly move to a closed position to dispose the noses of the pawls above the annular recess 50 in the upper driving head as shown in Figure 5. Initial upward movement of the lower driving head causes the annular shoulder 72 thereof to first release the pawls from their interlocking engagement with the upper driving head, and then to move into driving engagement with the annular shoulder 61 of the reciprocating member and maintain the pawls in their retracted positions. When the various parts of the mechanism assume the positions shown in Figure 5, the cycle of operations has been completed and will be repeated by continuing rotation of the power shaft 30 in the same manner as above described.

This mechanism may be advantageously employed in many different fields and wherever it is necessary to impart movements in opposite directions to a movable part at the same velocity. Among the possible fields of use for this mechanism, may be mentioned the valve art, in which the device may be advantageously employed for causing a rapid and positive opening and closing movement of a valve which may be very effectively timed by turning the handle 34 and causing the power shaft to shift longitudinally while continuing driving rotation, in order to turn the worm wheel and shift the double cam relative to the cams of the upper and lower driving heads.

It is to be understood that various changes in the size, shape and arrangement of parts may be resorted to without departing from the spirit of the invention, or the scope of the appended claims.

I claim:

1. In a device of the class described, a movable member, means for moving the same in opposite directions, said means being alternately free of connection with said member, and means for automatically and alternately rendering said movable member subject to the alternate action of said first mentioned means.

2. In a device of the class described, a movable member, opposed spring means for positively moving said member in opposite directions, said means being alternately free of connection with said member, and means for automatically rendering said movable member subject to the action of said spring means, alternately.

3. In a device of the class described, a movable member, opposed spring means for positively moving said member in opposite directions, said means being alternately free of connection with said member, cam means for alternately releasing said spring means, and means for automatically establishing a driving connection between said movable member and said opposed spring means, alternately.

4. In a device of the class described, a reciprocating member, opposed spring means for positively moving said member in opposite directions, said means being alternately free of connection with said member, cam means for simultaneously tensioning said opposed spring means and alternately releasing the same, and means for automatically establishing a driving connection between said reciprocating member and said spring means, alternately.

5. In a device of the class described, a movable member, means for moving the same in one direction, means for moving said member in the opposite direction, and interlocking means operable to establish a driving connection between said member and said first mentioned means and being operable to release said member and permit its movement independently of said means under the influence of said second mentioned means.

6. In a device of the class described, a movable member, means for moving the same in one direction, means for moving said member in the opposite direction, interlocking means operable to establish a driving connection between said member and said first mentioned means and being operable to release said member and permit its movement independently of said means under the influence of said second mentioned means, and means for subsequently moving said first named means to a position to re-establish the engagement of said interlocking means with said member.

7. In a device of the class described, a reciprocating member, means for moving the same in one direction, means for moving said member in the opposite direction, a spring pressed latch carried by said member and releasably interlocked with said first mentioned means, said latch adapted to be operated to release its interlocking engagement with said first mentioned means upon operation of said second mentioned means to allow said member movement independently of said first mentioned means.

8. In a device of the class described, a reciprocating member, means for moving the same in one direction, means for moving said member in the opposite direction, a spring pressed latch carried by said member and adapted to be releasably interlocked with said first mentioned means, said latch adapted to be operated to release its interlocking engagement with said first mentioned means upon operation of said second mentioned means to allow said member movement independently of said first mentioned means, and means of subsequently moving said first mentioned means to a position to re-establish interlocking engagement of said latch with said first mentioned means.

9. In a device of the class described, a reciprocating member, elements for alternately moving said member in opposite directions, and movable abutment means adapted to establish a releasable connection between one of said elements and said reciprocating member, and being released after completion of movement of said element in one direction and re-established upon movement of said element in the opposite direction.

10. In a device of the class described, a reciprocating member, alternately operable elements for alternately moving the same in opposite directions, and a spring pressed latch connected to said reciprocating member for establishing a releasable connection with one of said elements and being released after completion of movement of said element in one direction to permit relative movement between said element and said reciprocating member, said connection of said member with said element being re-established upon movement of said element in the opposite direction.

11. In a device of the class described, a reciprocating member, alternately operable elements for alternately moving the same in opposite directions, and a spring pressed latch movable into and out of said reciprocating member for establishing a releasable connection with one of said elements and being released after completion of movement of said element in one direction to permit relative movement between said element and said reciprocating member, said connection of said member with said element being re-established upon movement of said element in the opposite direction.

12. In a device of the class described, a reciprocating member, alternately operable elements for alternately moving the same in opposite directions, said reciprocating member being slidably associated with said elements, a releasable connection between one of said elements and said reciprocating member, whereby said member is moved in one direction by said element, the other element being movable to release said releasable connection and to move said reciprocating member independently of said first named element, and means for subsequently moving said first named element to re-establish its releasable connection with said reciprocating member.

13. In a device of the class described, a reciprocating member, alternately operable opposed spring pressed driving heads for alternately moving the same in opposite directions, said reciprocating member being slidable through said elements, one of said driving heads being provided with an internal shoulder, a spring pressed pawl carried by said reciprocating member and adapted to be engaged with said shoulder to establish a driving connection between said reciprocating member and said driving head, whereby said reciprocating member is positively moved in one direction by said spring pressed head, the other spring pressed head being provided with an abutment adapted to engage said pawl and release the same from said shoulder of the other spring pressed head upon movement of the second spring pressed head to free the reciprocating member from said first mentioned head, and to permit it to move under the influence of said second spring pressed head.

14. In a device of the class described, a reciprocating member, alternately operable spring pressed elements for alternately moving the same in opposite directions, said reciprocating member being slidably associated with said elements, cam means for simultaneously tensioning said spring elements and for alternately releasing the same to such spring action, a releasable connection between one of said elements and said reciprocating member whereby said member is moved in one direction by said element, the other element being movable to release said releasable connection and to move said reciprocating member independently of said first named element in the opposite direction, and said cam means serving to subsequently re-establish said releasable connection upon movement of said spring pressed elements to simultaneously tension the same.

15. In a device of the class described, a rotary shaft, a reciprocating member, a member rotatably mounted upon said reciprocating member and having upper and lower opposed cams, an upper spring pressed driving element having cams cooperating with the upper cams of said rotary member; said driving element being provided with an internal annular groove, a spring pressed pawl mounted in said reciprocating member and adapted to engage said annular groove to form a releasable connection between said reciprocating member and said driving element, whereby the latter moves the reciprocating element in one direction under the influence of said spring action when released by said upper cam, a second spring pressed driving element slidably associated with said reciprocating member and having a cam cooperating with said lower rotary cam, said lower driving element having a shoulder for engagement with said pawl upon release of said lower driving element to its spring action to disengage said pawl from said groove of said upper driving element and to move said reciprocating member independently of said upper driving element, and said rotary cams serving to subsequently move said upper driving element so as to reestablish its connection with said pawl.

16. In a device of the class described, a reciprocating member, alternately operable opposed spring means for alternately mov-

ing the same in opposite directions, means for normally urging said reciprocating member in one of said directions, said alternately operable spring means being alternately active to move said member, and means for alternately and automatically rendering said reciprocating member subject to the alternate action of said spring means.

17. A device of the class described, comprising a movable member, means for moving the same in one direction, means for moving said member in the opposite direction, abutment means adapted to establish a releasable connection between said first named means and said member and being releasable upon movement of said second mentioned means, and means to normally urge said member to a position whereby said abutment means can re-establish said releasable connection, and means for subjecting said member to the action of said first and second mentioned means alternately.

18. Means for converting rotary into reciprocating movement comprising a reciprocating member, opposed elements alternately movable in opposite directions, said elements being alternately free of said reciprocating member, and means for alternately establishing a driving connection between said reciprocating member and said elements.

19. Means for converting rotary into reciprocating movement comprising a reciprocating member, cam means, opposed spring pressed elements alternately active to move said reciprocating member and alternately released to their spring action by said cam means, and means for alternately establishing a driving connection between said reciprocating member and one of said elements.

20. Means for converting rotary into reciprocating movement comprising a reciprocating member, rotary cam means mounted loosely thereon, opposed elements actuated by said cam means for alternately moving said said member in opposite directions, said elements being alternately free of said reciprocating member, and interlocking means between one of said elements and said reciprocating member for causing movement of the latter in one direction, and releasable at a predetermined time to permit independent movement of said reciprocating member in the opposite direction.

21. Means for converting rotary into reciprocating movement comprising a reciprocating member, opposed spring pressed elements alternately active to move said reciprocating member and alternately released to their spring action by said cam means, said elements being alternately free of said reciprocating member, and coupling means between one of said elements and said reciprocating member normally active to establish a driving connection between said member for moving the same in one direction, and releasable at a predetermined time to permit independent movement of said reciprocating member upon operation of said other element.

22. The combination with a worm wheel, a cam carried thereby, means operated by said cam, a worm shaft for driving said worm wheel, said worm shaft being rotatably and slidably mounted, a set of stationary threads, and a threaded member carried by said shaft and operatively associated with said threads for adjusting said shaft longitudinally.

23. The combination with a reciprocatory member, actuating means therefor including an element slidably mounted on the reciprocatory member, and a cam member rotatably and slidably associated with said reciprocatory member for moving said slidable element, means for coupling the slidable element to said reciprocatory member for moving the latter in one direction; of means for adjusting the relative position of said cam member with respect to the slidable element during movements of the reciprocatory member.

24. The combination with a reciprocatory member, actuating means therefor including an element slidably mounted on the reciprocatory member, and a driven member rotatably and slidably mounted upon said reciprocatory member, cooperating cam faces on said sliding and rotary members, means for coupling the sliding element to said reciprocatory member for moving the latter in one direction; of means for adjusting the relative position of said cam faces during movement of said members.

25. In a device of the class described, a movable member, opposed spring means for moving said member in opposite directions, said means being alternately free of connection with said member, cam means for alternately releasing said opposed spring means, means for automatically establishing a driving connection between said movable member and said opposed spring means alternately, and means for adjusting the relative position of said cam means with respect to said spring means during movements of said member.

26. The combination with a reciprocatory member, actuating means therefor including an element slidably mounted on the reciprocatory member, a cam member rotatably and slidably associated with said reciprocatory member for moving said slidable element, means for coupling the slidable element to said reciprocatory member for moving the latter in one direction; of rack and pinion means for turning the cam member to vary its position with respect to the slidable element during movements of the reciprocatory member.

In testimony whereof I have hereunto set my hand.

ROBERT C. ROEBLING.