June 2, 1953 E. S. GIFFIN 2,640,346

COMBINATION-OPERATED MECHANISM

Filed April 27, 1951 2 Sheets-Sheet 1

Fig. 1.

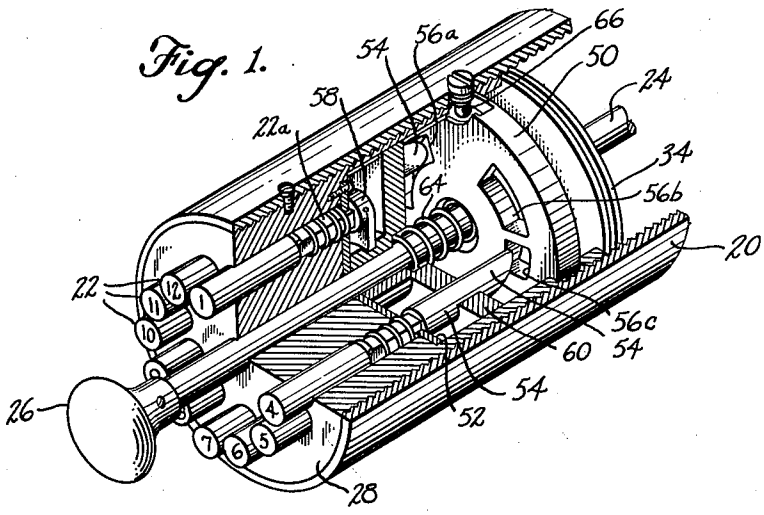
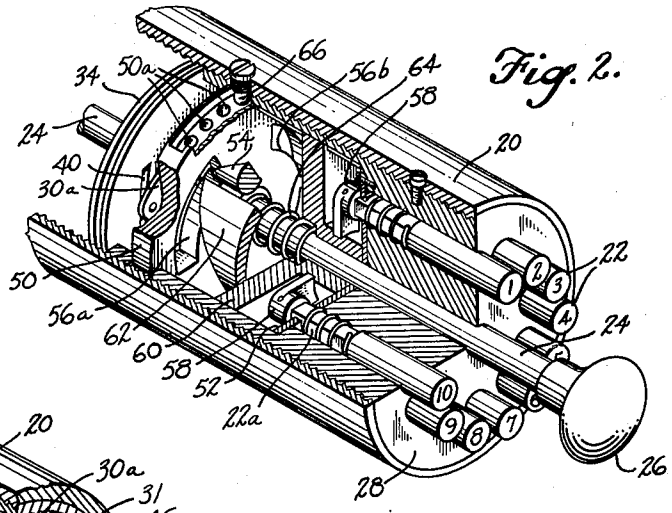


Fig. 2.



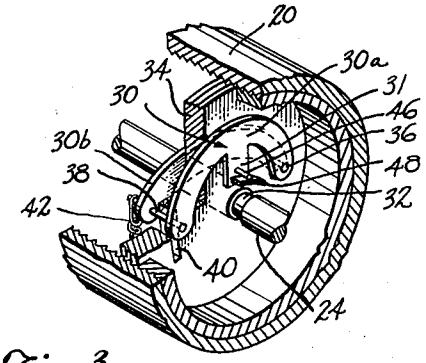


Fig. 3.

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Fig. 8.

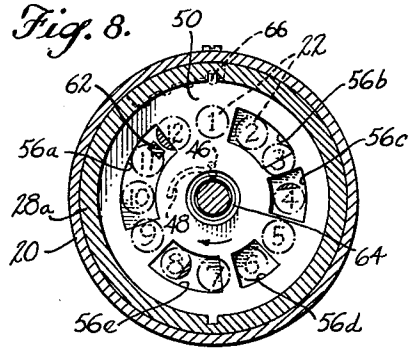


Fig. 4.

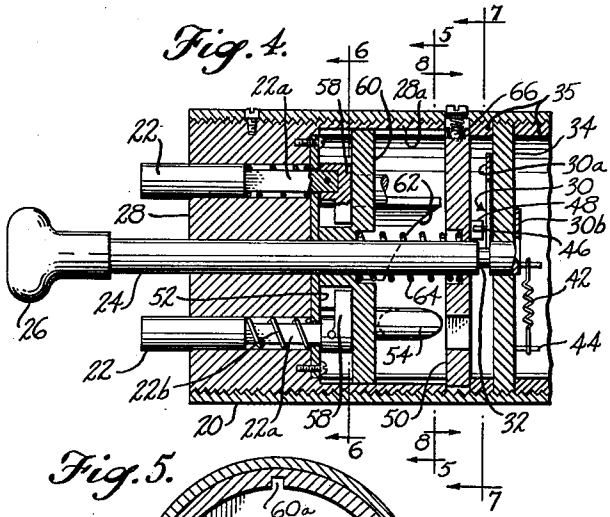


Fig. 9.

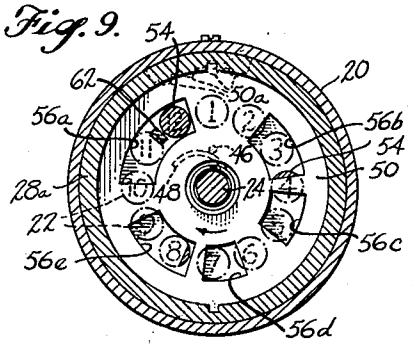


Fig. 5.

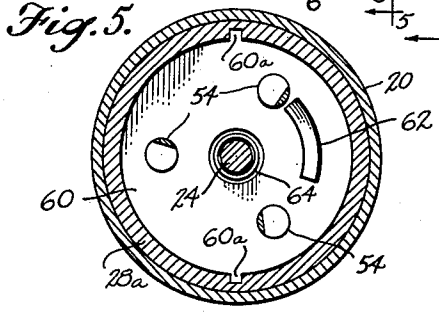


Fig. 10.

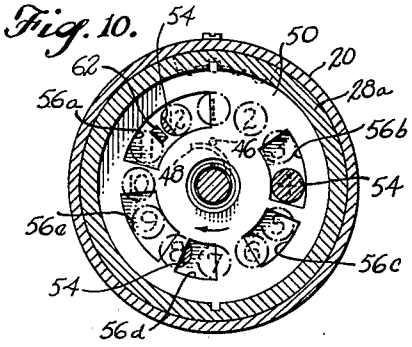


Fig. 6.

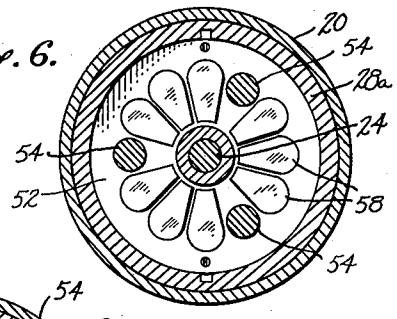
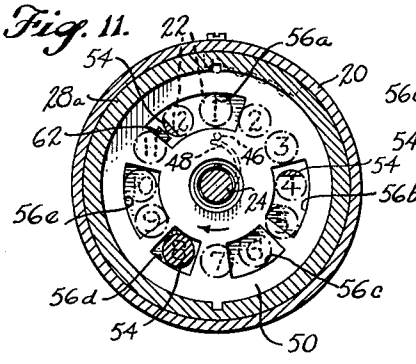


Fig. 11.



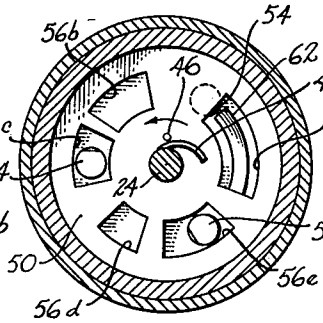


Fig. 7.

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Patented June 2, 1953

2,640,346

UNITED STATES PATENT OFFICE

2,640,346

COMBINATION-OPERATED MECHANISM

Edward S. Giffin, Auburn, Wash.

Application April 27, 1951, Serial No. 223,297

5 Claims. (Cl. 70—313)

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This invention presents combination-operated mechanism of the type including a controlled member which can be moved in the desired manner for accomplishing a given end result only if selected control elements of a plurality of such elements are manually actuated in predetermined combination sequence. The invention is herein illustratively described in its preferred form and as embodied in a push-button operated combination lock mechanism. It will be appreciated, however, that features of the novel mechanism might also be employed in related or similar applications, and further that details of form of the different parts and subcombinations may vary within the scope of the invention set forth herein and claimed.

A general object of the invention is a practical combination-operated mechanism, such as a lock or the like, of the push-button type. Such a lock might, for example, be applied to an automobile ignition switch control as herein mentioned. The chief advantage of a push-button controlled combination lock over a rotative dial type, for example, in that and similar applications, is that the control push buttons may be actuated quickly and in proper sequence even under poor lighting conditions and without leaning down or straining to see the numbers on the dial. After becoming familiar with a lock of the present type the control buttons may be operated simply by feel. Critically adjusted dial operated combination locks usually require good visibility of the dial numbers and are more tedious to operate.

Another object of the invention is a tamper-proof, rugged combination lock, or the like, which is relatively compact and lends itself to a variety of different useful applications.

Still another object is combination-operated mechanism of the type described in which the parts are subject to but slight wear and the lock as a whole is thereby very durable.

In its illustrated form, the push-button operated combination lock is applied to a control rod, reciprocation of which may open and close an ignition switch, for example. The rod is guided for such control movement in a cylindrical lock casing end closure. In accordance with the invention, the differently numbered or labeled push buttons are mounted in such end closure, preferably grouped in circular series around the rod. The latch member ultimately actuated by the mechanism is normally engageable by spring action with a notch in the rod when the latter reaches locking position. The latch is moved out of the notch to release the rod by progressive rotational movement of a latch-shifting component, generally referred to as the controlled member of the mechanism, through a predetermined angle representing the summation of successive incremental shifts imparted thereto by pressing predetermined control push buttons in proper sequence. The effect of pressing one of the remaining push buttons, which are dummies and do not enter into the combination, is to return the latch-actuating component to its initial position and thereby eradicate any progress theretofore made toward successful completion of the operating combination.

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More specifically each control push button, of which there are three in the example, operates an individual control actuator or striker for engagement thereof with a different actuator-impelled abutment or strike carried by the controlled member to impart incremental circumferential shifting of such member each time a proper control push button is pressed. In the example the controlled member includes a revoluble disk having apertures therein, the end edges of which are slidably contacted by inclined surfaces on the respective strikers to wedge the disk circumferentially as the strikers advance parallel to the disk's axis.

Manual shifting of the first push button in the combination positions the controlled member with an abutment ready for engagement by the second push-button operated striker, and such shifting of the second push button accomplishes the same result for the third, etc., until the combination is executed and the controlled member disk attains its final or latch-releasing position. A spiral cam and follower or other suitable means converts progressive angular movement of such disk into shifting the latch away from the switch control rod, as desired.

Each of the dummy push buttons is adapted to actuate a return striker having a reversely inclined wedging surface which engages a controlled member disk abutment and wedges such disk circumferentially back to its initial position, from any position thereof established by control push-button operation. To permit use of a common return actuator or striker for all dummy push buttons without disclosing which are dummies and which are control push buttons, all of the push buttons are pressed outward by independent return springs and the return striker is carried by a slide disk operatively advanced by actuation of any of the dummy push buttons but returned by an independent return spring. Moreover, the sensation of pressing a dummy

push button is practically the same as that of pushing a control push button. In each instance the inclined surface of a striker wedgingly engages a strike carried by the controlled member disk, and the latter yields to such wedging action.

Other features, objects and advantages of the invention including various details of the preferred form thereof as mentioned above, will now be described with greater particularity by reference to the accompanying drawings.

Figure 1 is a perspective view of a push-button operated combination lock embodying the invention, parts being broken away to show interior details.

Figure 2 is another perspective view of the same from a different aspect and showing other details by break-away sectioning.

Figure 3 is a fragmentary perspective view illustrating latch mechanism details.

Figure 4 is a longitudinal sectional view of the lock.

Figure 5 is a transverse sectional view taken on line 5—5 in Figure 4.

Figure 6 is a similar sectional view taken on line 6—6 in Figure 4.

Figure 7 is a similar sectional view taken on line 7—7 in Figure 4.

Figure 8 is a transverse sectional view taken on line 8—8 in Figure 4 with the controlled member in its initial position.

Figure 9 is a view corresponding to Figure 8 with the controlled member in its second position established by pressing the first push button of the combination.

Figure 10 is a similar view in which the controlled member is in its third position established by pressing the second push button of the combination.

Figure 11 is a similar view in which the controlled member is in its fourth and ultimate position established by completing the operating combination of the lock, the lock having three control push buttons and nine dummy push buttons in the illustrated case.

Tubular lock casing 20 supports and encloses all parts of the combination-operated lock mechanism except the push buttons 22 and the end of a slide rod 24 having a handle 26. The push buttons are slidably mounted in circular series arrangement concentrically of the casing, in an end closure plug 28 threaded into the end of such casing. The rod 24 passes slidably through a central bore in this plug.

In the illustrated case the reciprocable rod 24 constitutes an automobile ignition switch control rod. Details of an ignition switch and of its connection to the control rod are omitted from the drawings as they form no part of the present invention. In its position shown in Figure 4 the control rod is locked against lengthwise reciprocation in a position which would correspond to the automobile ignition switch being held open. A part of latch 30 (Figures 3 and 4) is lodged in a notch 32 in the rod and must be lifted therefrom by proper actuation of the numbered push buttons 22 before the control rod can be moved lengthwise to close the automobile ignition switch and start its engine. The present invention concerns novel combination operated mechanism by which the latch is actuated to release the control rod or other locked member.

The latch 30 comprises two parallel plates 30*a* and 30*b* of general crescent shape, one immediately adjacent to each side of a supporting disk 34 which is threaded into the lock casing 20 and

held by tubular spacers 35 some distance from the closure plug 28. Corresponding ends of the two latch plates are pivoted coaxially by a pivot pin 36. Such pin passes snugly through a bore in the disk 34 located out from the latter's center such that the general midportion of the latch plate 30*b* will drop into the notch 32 of the control rod 24, shown in Fig. 4, when such plate is swung inward toward the rod. The swinging ends of plates 30*a* and 30*b* are interconnected by a pin 38 passing through an arcuate slot 40 in the disk 34. Swinging of plate 30*a* will effect simultaneous swinging of plate 30*b*. Such swinging of plate 30*a* is effected by a force exerted by the lock mechanism controlled member on a pin 46 carried by a tab 31 projecting radially inward from approximately the central portion of the plate. Upon release of this pin by the controlled mechanism, a latch return spring 42, shown in Figures 3 and 4 as being connected between an extension of pin 38 and an anchor pin 44 on disk 34, urges the latch plates toward the control rod. Normally, therefore, the central portion of plate 30*b* contacts the rod to drop into its notch whenever it registers with such plate as the rod is reciprocated. Plate 30*a* is curved much sharper than plate 30*b* to dispose the inner end of tab 31 always outwardly of the central inner edge portion of plate 30*b* a distance greater than the depth of notch 32, to clear rod 24.

Lift pin 46 is engageable by and rides on a spiral cam 48 projecting from the adjacent face of a rotative disk 50 located adjacent the latch-supporting disk 34. The disk 50 carrying the spiral cam constitutes the controlled member of the illustrated mechanism. When this disk and its cam are progressively rotated in the direction of increasing radius of the cam spiral contacted by the lift pin 46 the latter is pressed outwardly against the force of spring 42 to raise the latch 30 out of locking engagement with the notch 32 in the control rod. The total angle through which the revoluble disk must rotate to clear the latch strip 30*b* from the rod notch 32 need not be great. However, friction of the lift pin 46 on the cam surface, opposing rotation of the cam, may become excessive if the cam spiral pitch or slope is made too great in an effort to minimize the rotation angle of the cam necessary to unlock the control rod 24.

The novel combination operated mechanism of this invention utilizes the push buttons 22 for moving the controlled member (disk 50) in a manner which will now be described. In the illustrated case the push buttons numbered 12, 4 and 8, in that sequence of actuation, represent the operating combination of the lock. The remaining push buttons, namely those numbered 1, 2, 3, 5, 6, 7, 9, 10 and 11, are dummies or reset buttons.

Each of the push buttons constitutes an endwise extension of a separate plunger rod 22*a* of rectangular cross section. A circular plate 52 is clamped by screws upon the inner end of the closure plug 28 and has rectangular openings aligned with the push button bores in the plug, in which openings the respective plunger rods may slide lengthwise but cannot rotate. Push button return springs 22*b* encircling the individual rods 22*a* bear against the plate 52 and urge the push buttons outwardly.

The inner ends of the plunger rods 22*a* associated with control push buttons carry cylindrical strikers 54 the butts of which act as push-button return stops and the tips of which project toward the revoluble disk 50. These strikers are

of equal length and each has an inclined end face defined by a longitudinally inclined cutting plane which intersects the plane containing the lock casing axis and the particular plunger axis in a radial line which is perpendicular to both of these axes. The revoluble disk 50 has a circular group of arcuate slots 56*a*, 56*b*, 56*c*, 56*d* and 56*e* which in the initial position of the disk preparatory to pressing the first push button (12) of the lock combination bear the relationship to the different push buttons as shown in Figure 8. In this initial rotated position of the disk 50 its apertures 56*c* and 56*e* are in registry with the control push buttons numbered 4 and 8, respectively, and when these push buttons are pressed inward and then released their cylindrical strikers merely move in and out of the registered apertures without contacting the disk 50. However, should the initial push button of the combination, namely No. 12, be pressed, the inclined face of its striker 54 advances into wedging sliding contact with one end of the circumferential slot 56*a* constituting a striker abutment. As the push button 12 is advanced further, the inclined face of its striker sliding against such slot end causes the revoluble disk 50 to rotate slightly by circumferential wedging action of the striker. The disk moves clockwise as viewed in Figure 8. Following completion of the inward stroke of push button 12 the revoluble disk is left rotatively positioned as in Figure 9 and the striker of the second push button of the combination, namely No. 4, is now aligned with the corresponding end edge of the slot 56*b*. If this push button is then pressed the revoluble disk 50 will be rotated by another increment in the same direction as previously by circumferential wedging action of this push button's striker. On the other hand should either of the push buttons 12 or 8 be pressed instead, their strikers will move in and out of the openings of slots 56*a* and 56*e*, respectively, and have no effect.

Following actuation of push button 4, the second in the combination, the revoluble disk is rotatively positioned as in Figure 10. Now the push buttons 12 and 4 are fully aligned with the openings of the respective slots 56*a* and 56*b* whereas the striker of push button 8 is enabled to rotate the disk by another increment by wedging engagement of such striker's inclined face with the end edge of slot 56*d*. That completes the combination and positions the revoluble disk as in Figure 11.

The accumulative effect upon the latch position of incremental movements of the disk 50 effected by pressing the control push buttons in proper sequence may be noted by reference to the progressive positioning of the latch lift pin 46 effected by rotation of cam 48 as illustrated in Figures 8 to 11, inclusive. The position of the latch shown clearly in Figure 3 corresponds with the operating position of the parts attained in Figure 11, the control rod 24 being released for lengthwise movement unrestrained by the latch plate 30*b*.

The rotative disk 50 carrying the latch-actuating spiral cam 48 remains in its position of Figure 11 until one of the dummy push buttons, 1, 2, 3, 5, 6, 7, 9, 10 or 11 is pressed, the disk apertures 56*a*, 56*b*, and 56*d* being then in registry with the strikers of the respective push buttons 12, 4 and 8. Upon the inner end of each plunger rod 22*a* of the dummy push buttons is carried a radially elongated striker or foot 58. A disk 60 is slidably received inside a cylindrical skirt 28*a* constituting an inward extension of the closure plug 28.

A cam-like return or resetting striker 62 in the form of a hollow cylinder section projects from the inner face of the slide disk 60 toward the revoluble disk 50 (Figure 4). The end face of this striker is helically inclined with relation to the rotational axis of the disk 50 and lies generally at a radius therefrom equal approximately to the average radius of the arcuate slots 56 in such disk. The tip of this striker 62 appears in each of Figures 8 to 11, inclusive, and is always held in such rotative position by a pair of keys 60*a* on the slide disk engaged in keyways in the skirt 28*a* of the closure plug to locate the disk in correct circumferential position. Such holding of the disk against rotation also prevents it from binding on the shanks of the cylindrical strikers 54 which pass slidably through the disk 60.

A spring 64 encircling the rod 24 and reacting from the rotative disk 50 urges the slide disk 60 against the feed 58 of the dummy or resetting push buttons 22, with the cam-like striker 62 withdrawn from the revoluble disk as shown in Figure 4. When any of the dummy push buttons is pressed, therefore, its foot advances the slide disk, hence the resetting striker 62, toward the rotative disk against the increasing pressure of spring 64. If the rotative disk is then in its initial position, as shown in Figures 7 and 8, the striker 62 will simply enter the arcuate slot 56*a* without contacting the revoluble disk, so that the latter's position will remain unchanged by pressing a dummy push button. However, if one of the dummy push buttons is pressed at any stage of completion of the operating combination of the lock, depicted in any of Figures 9, 10 or 11, then the helically inclined inner end of the striker 62 will contact the end of the slot 56*a* away from the striker 54 of control push button 12. Such contact will be made at an earlier point during the progressive inward movement of the dummy push button being pressed if the revoluble disk 50 is positioned at the second stage of the operating combination, as shown in Figure 9, than when it is positioned in the succeeding stage of Figure 10, and still more so than when disk 50 is in its ultimate position shown in Figure 11.

In any case, however, progressive inward advance of any dummy push button, hence of the cam striker 62, causes progressive wedging of the latter against the end of slot 56*a* to rotate the disk 50 backward fully to its initial position, or counterclockwise in any of Figures 8 to 11, inclusive. Thus the dummy push buttons serve as a means of disengaging the spiral cam 48 from the latch lift pin 46 to enable relocking of the control rod 24 when it is moved lengthwise until its slot 32 attains registry with the spring urged latch 30. The latch return spring 42 will then complete the locking operation by snapping the latch plate 30*b* down into the rod notch.

In operating the novel push button combination lock, therefore, the initial step required is to press one of the dummy push buttons in order to position the revoluble disk 50 at its starting point in which its latch-release spiral cam 48 is retracted circumferentially from the latch lift pin 46 and the end edge of the slot 56*a* is aligned with the inclined end face of the striker 54 of push button 12 (Figure 8). Then the push buttons 12, 4 and 8 are pressed sequentially in the order named to rotate the disk 50, hence the cam 48, progressively by increments until the final posi-

tion of Figure 11 is reached in which the latch lift pin **46** has ridden to its maximum high point on the spiral cam **48**. The latch plate **30***b* is then clear of the control rod notch **32** and the control rod unlocked for lengthwise movement to operate the automobile ignition switch or other controlled device.

As a further refinement of the combination-operated mechanism, the peripheral edge of the revoluble disk **50** has a succession of detent holes **50***a* each of which is engaged by a spring-urged detent ball **66** in a different position of the disk representing a stage of the operating combination of the lock. The detent **66** holds the disk **50** against rotation out of any of its established interim positions through the effects of vibration, pounding or other disturbing influences which might otherwise dislocate the settings of the latch release cam **48**. Moreover, the detent **66** holds the disk **50** against the slight restoring force exerted upon it by latch return spring **42** which presses the latch lift pin **46** against the sloping surface of the spiral cam **48**.

Although the control push button strikers have been illustrated and described as producing cumulative incremental shifts or progressive movement of the revoluble disk **50** in the same direction to complete the mechanism combination, it will be seen that one or more interim control buttons in a more complex version of the mechanism might be designed to produce reverse or subtractive movement of such disk. Also the increments of movement of the disk effected by the control push button strikers need not necessarily be equal; thus the inclination of their wedging surfaces may differ. The actuation movement of all the push buttons is preferably made equal, however.

I claim as my invention:

1. Combination-operated mechanism comprising a controlled member, means guiding said controlled member for movement between an initial position and a final position, a plurality of manually shiftable elements guided for independent reciprocation, and controlled member moving means comprising first advancing actuating means operated by reciprocation of one of said elements and operable to effect incremental movement of said controlled member from its initial position toward its final position, second advancing actuating means operated by reciprocation of a second of said elements and operable to effect a further incremental movement of said controlled member toward its final position, a return single wedging member operable to effect movement of said controlled member toward its initial position, and means movable by any of a plurality of said manually shiftable elements and operable by movement thereof to effect wedging actuation of said single wedging member to effect return movement of said controlled member.

2. The mechanism defined in claim 1, wherein the controlled member is a disk, the advancing actuating means include controlled member advancing strikers which are generally cylindrical

rods having elliptical inclined end faces constituting wedging surfaces, and the return single wedging member is an arcuate striker having a helical end face wedgingly engageable with the controlled member.

3. Mechanism defined in claim 1, wherein the means movable to effect wedging actuation of the striker is a spring-returned disk carrying the striker and axially reciprocable by reciprocation of any one of the manually shiftable elements engageable therewith.

4. Combination operated mechanism comprising a plurality of plungers having wedging surfaces on corresponding ends thereof, means supporting said plungers and guiding them for independent lengthwise reciprocation, a controlled member having a plurality of elongated apertures therein of substantially equal length, one corresponding to each of said plungers, and each of said apertures having thereacross between its ends a bridge engageable by the wedging surface of the plunger corresponding to such aperture, and the bridge in each aperture being located in a position along the length of such aperture different from the position of the bridge along the length of another aperture, and means guiding said controlled member for movement lengthwise of its apertures by the force exerted by the wedging surface of the plunger aligned with the bridge in its corresponding aperture engaging such bridge, the other plungers being movable unobstructedly through their apertures.

5. Combination operated mechanism comprising a plurality of plungers having wedging surfaces on corresponding ends thereof, means supporting said plungers arranged in a circle in substantially parallel relationship and guiding them for independent lengthwise reciprocation, a controlled disk having a plurality of arcuate elongated apertures therein of substantially equal circumferential length, one corresponding to each of said plungers, and each of said apertures having thereacross between its ends a radially extending bridge engageable by the wedging surface of the plunger corresponding to such aperture, and the bridge in each aperture being located in a position along the length of such aperture different from the position of the bridge along the length of another aperture, and means guiding said controlled member for rotary movement by the force exerted by the wedging surface of the plunger aligned with the bridge in its corresponding aperture engaging such bridge, the other plungers being movable unobstructedly through their apertures.

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