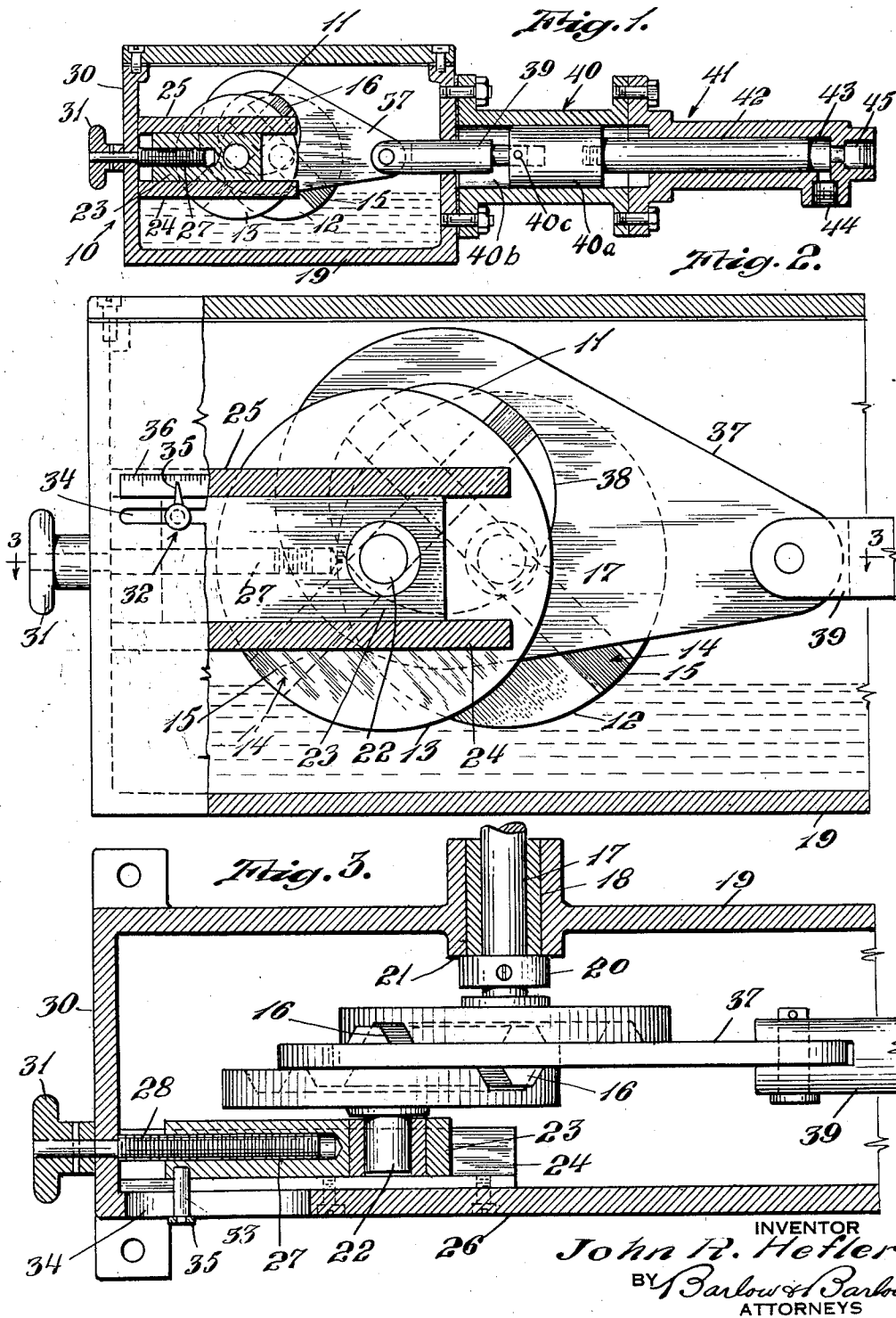


Filed July 4, 1945

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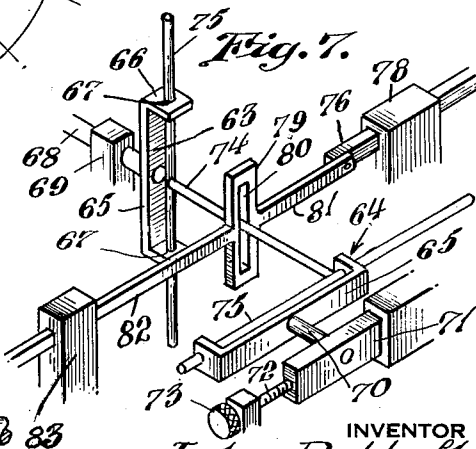
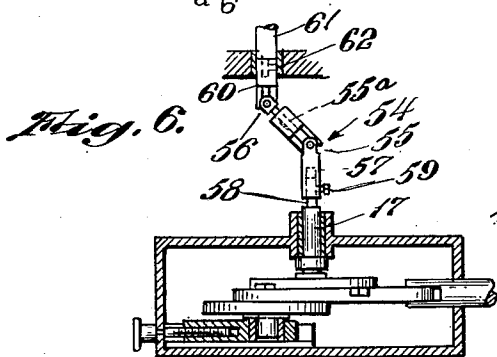
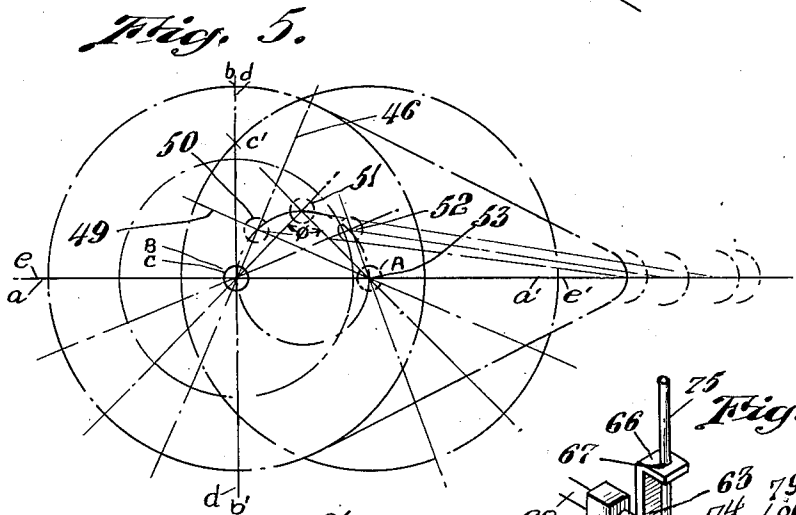
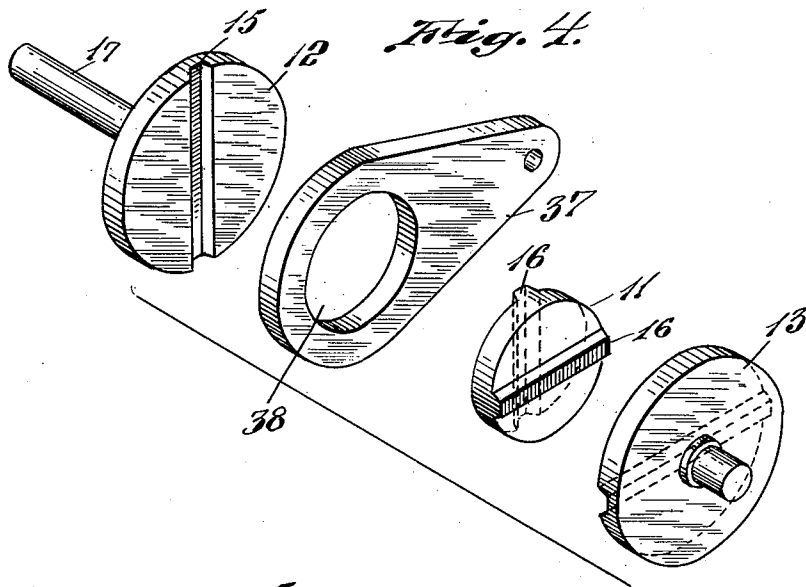
April 11, 1950

J. R. HEFLER
MECHANISM FOR CONVERTING ROTARY MOTION TO
LINEAR RECIPROCATING MOTION

2,503,907

Filed July 4, 1945

2 Sheets-Sheet 2



INVENTOR
John R. Heffler
BY *Barlow & Barlow*
ATTORNEYS

UNITED STATES PATENT OFFICE

2,503,907

MECHANISM FOR CONVERTING ROTARY
MOTION TO LINEAR RECIPROCATING
MOTION

John R. Hefler, Providence, R. I.

Application July 4, 1945, Serial No. 603,228

11 Claims. (Cl. 74—44)

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This invention relates to an adjustable mechanism for converting rotary motion to linear reciprocating motion, particularly its application to reciprocating plunger or diaphragm pumps of the type employed to meter or proportion various fluids.

It is desirable to provide in a mechanism of this character means for changing the amplitude of movement of the reciprocated part while in motion by means of some element normally stationary relative to the moving part of the device. It is also desirable to control the movement of the reciprocated part so as to accelerate its rate of travel in one direction and retard its rate of travel in the opposite direction.

An object of the invention is the provision of a mechanism in which the amplitude of movement of the reciprocated part may be controlled while in motion.

Another object of the invention is the provision of a mechanism in which the amplitude of movement of the reciprocated part may be controlled while in motion by means of a normally stationary part.

Another object of the invention is the provision of a mechanism in which the amplitude of movement of the reciprocated part may be varied while in motion and in which the change in direction of travel of the reciprocated part will be from a predetermined fixed point at all amplitudes of movement of the reciprocated part.

Another object of the invention is the provision for controlling the rate of movement in either direction of travel of the reciprocated part.

A more specific object of the invention is the provision of a crank mechanism for a pump in which the amplitude of movement of the pump plunger may be varied while in motion.

Another object of the invention is the provision of a crank mechanism for a pump in which the amplitude of motion of the pump plunger may be varied at constant clearance of pump plunger.

Another object of the invention is the provision of a crank mechanism for a pump in which the amplitude of movement of the pump plunger may be varied while in motion by means of a part normally stationary.

Another object of the invention is the provision of a crank mechanism for a pump in which the rate of movement of the pump plunger in either direction may be controlled.

With these and other objects in view, the invention consists of certain novel features of construction, as will be more fully described and

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particularly pointed out in the appended claims.

In the accompanying drawings:

Fig. 1 is a sectional view of a crank mechanism, a crosshead slide and a pump combined embodying my invention;

Fig. 2 is an elevational view partially in section of the crank mechanism shown in Fig. 1 on an enlarged scale;

Fig. 3 is a sectional view taken substantially on line 3—3 of Fig. 2;

Fig. 4 is an exploded view showing elements forming part of the crank mechanism;

Fig. 5 is a diagram showing a partial cycle of motion of the crank mechanism;

Fig. 6 is a plan view partially in section showing the means for transmitting motion to the crank mechanism; and

Fig. 7 is a diagrammatic view of a modified construction of a crank mechanism.

In general the invention comprises a crank mechanism in which two cranks are provided and which are hereinafter designated as guide members. These guide members are positioned opposite to each other and rotated about axes which extend substantially parallel to each other and which can be spaced in non-coaxial relation to each other. Each guide member has a linear guiding element or elements thereon at right angles to the axis of rotation. The crank pin is in the form of a floating eccentric located between two guide members having guide elements on either side thereof at an angle with each other, which slidably engage the two guide members.

The engagement of the crank pin is such as to transmit positive rotary motion directly from one guide member to the other while maintaining fixed angles between their guide elements. Rotation of the guide members when they are not coaxial produces an eccentric motion of the crank pin since the apex of the angle between the guide elements must move in a circular path between the axis of the guide members. This is due to the fact that in a circle all inscribed angles subtended by the same arc are equal and therefore the locus of the apex of a fixed angle between two points will be the arc of a circle connecting the two points.

The size of the circle will be determined by the axial displacement between the guide members and is zero when the two guide members rotate coaxially, increasing with greater displacement. The center of the circle will therefore move relative to the axis of rotation of the guide members so that when the axis of one guide member is fixed and the other moved the ampli-

tude of throw and the center will be changed. If the guide elements on the crank pin are at right angles on its axis, the crank pin will provide a crank motion in a circle whose diameter is equal to the axial distance between the guide members. In the mechanism means are provided for moving the axes of rotation of the guide members in relation to each other so as to decrease or increase the throw of the crank pin by predetermined amounts. A connecting rod, eccentric strap or other linkage is provided for operatively connecting the crank pin to a member guided for linear reciprocating motion, which may be straight line or curvilinear as desired.

The mechanism may also include a rotary variable speed device which can be made to alternately accelerate and slow down the rotation of the guide members so as to vary the rate of travel of the reciprocating guided member in one direction from that in the other direction.

Referring to the drawing for a more detailed description of the invention in which there is shown in Figs. 1 to 6, one embodiment of the invention, 10 designates generally the crank mechanism. This comprises a crank pin 11 which is mounted between oppositely disposed cranks or guiding members 12 and 13.

Each guide member is provided with a guide element 14 therein, which in the present instance is in the form of a groove 15 that extends diametrically across the face thereof, with the groove in one member positioned opposite and at substantially right angles to the groove in the opposite guide member. The crank pin 11 has on opposite sides tongues 16 which also extend substantially diametrically across the face thereof, with the tongue on one side positioned at right angles to the tongue on the opposite side. The tongues in cross section conform to the cross section of the grooves and are slidably received therein and maintain the grooves at a fixed angle relative to each other. The rotation of one guide member will be transmitted to the other guide member directly through the tongue and groove connections therebetween.

Extending from the guide member 12 there is a shaft 17 which is journaled in a bearing 18 provided in a housing 19 which encloses the crank mechanism. The housing may contain a lubricant in which the parts may rotate. A collar 20 is secured to the shaft and engages against a shoulder 21 surrounding the bearing 18 and prevents lateral movement tending separation of the guide members. The member 13 has a stub shaft 22 extending therefrom and parallel to shaft 17. This shaft 22 is journaled in a bearing block 23 which is mounted for slidable movement between guide strips 24 and 25 provided on a side wall 26 of the housing. The bearing block has a threaded opening 27 extending therein and is threadedly engaged by the shank portion of a captive adjusting member 28 which is rotatably mounted on the end wall 30 of the housing. A knob 31 is secured to the member 28 for manually rotating the same. Rotating the member 28 will slidably move the bearing block 23 to increase or decrease the spacing between the axes of the guide members depending upon the direction of rotation of member 28.

In order to predetermine the spacing between the axes of the guide members 12, 13, I provide an indicator 32 which comprises a pin 33 secured to the bearing block 23 to move therewith. The pin extends through a slot 34 in the wall 26 and is provided with a pointer 35 which will move

over a scale 36 graduated in appropriate increments so as to indicate the relative spacing between the axes of the guide members 12 and 13.

A pitman or link 37 is provided with a bearing opening 38 in which is journaled the crank pin 11. The link 37 is pivotally secured to a guided member 39 which may be in the form of a cross head guide 40 of a pump mechanism generally indicated 41 and having a usual pump plunger 42 actuating in a cylinder 43 having inlet and outlet ports 44, 45. The cross head may comprise a reciprocal member 40a guided in a cylinder 40b. In order to provide for overloads on the crank mechanism, the member 40a is connected to member 39 by means of a weak link device such as a shear pin 40c.

The operation of the crank mechanism thus far described is as follows: Rotary motion is transmitted at equal velocities from guide member 12 to guide member 13, through the tongue and groove connections between the guide members and crank pin. This in effect provides for the crank pin to be driven or moved equally by each guide member. The angle formed at the center of intersection of the grooves 15 will be a fixed right angle at all positions of rotation. The limit of movement of the crank pin center is confined from the axis of one guide member to the axis of the other guide member. Since the crank pin is free to move relative to each guide member and is equally moved thereby, its center will assume a position at the center of intersection of the grooves 15 in all positions of rotation. Therefore, in accordance with the geometrical fact that an angle inscribed in a semicircle is a right angle, the crank pin center will move in a circular path passing through the axes of the guide members 12, 13. This circular path will be described from a point or axis midway on a straight line passing through the axes of rotation of the guide members. Thus, the spacing of the axes of rotation of the guide members will determine the position of the axis of rotation of the crank pin center.

It will be apparent that the bearing block 23 may be moved to increase or decrease the spacing between the axes of rotation of the guide members so as to change the amplitude of motion of the reciprocated guided member from zero movement to maximum while in motion.

In Fig. 5 the plotting of the crank pin center as it will occur due to various positions of angularity or rotation of guide members is illustrated.

A, B, C represent the axis of members 12, 13 and crank pin 11 respectively, lines $a-a'$, $b-b'$ the grooves in members 12, 13 and lines $e-e'$, $e'-e'$ the tongues in the crank pin. In the assumed position B and C will be coaxial to each other. If lines $a-a'$ and $b-b'$ are advanced to position shown by lines indicated 46, 49, then lines $d-d'$ and $e-e'$ will also be advanced to position 46, 49. The intersection of these lines will be at position 50 which will locate position of C. Thus relocating the position of C as at 51, 52, and 53 will describe a circle representing the path of travel of C intersecting the axes of guide members 12, 13. It will be noted that for each half revolution of the guide members 12, 13 a complete revolution of crank pin center about its axis of revolution will be had. Thus for each rotation of guide members there are two rotations of the crank pin, which provides two complete reciprocations of the guided member 39.

Each of the axes of rotation of the guide members 12, 13 intersect the axis of reciprocation of

the guided member 39. Since the shaft 17 is fixed in position, the change in direction of travel of the reciprocated member at one end of its path of travel is at a fixed location. When the crank mechanism is employed to reciprocate the plunger or diaphragm of a pump and the zero displacement of the plunger or diaphragm of the pump has been established, then any change in the amplitude of the crank movement will be at a constant zero clearance of pump.

In order to provide for reciprocating the guided member 39 at a greater velocity in one direction of travel than in the other, I provide a rotary variable speed device 54. The device in the present instance is in the form of a plurality of universal couplings 55 and 56 joined in series. The coupling 55 is provided with a socket portion 57 which adjustably receives the reduced end portion 58 of the shaft 17 and a screw bolt 59 adjustably secures the portion 57 in position on the shaft. The coupling 56 also has a socket end portion 60 in which is received the reduced end portion of a main drive shaft 61. The opposite ends of the couplings are telescopically and rotatably connected to each other as at 55a. A screw bolt 62 secures the portion 60 to the shaft. These couplings have the property of alternately speeding up and slowing down twice in each revolution. The velocity of the speeding up and slowing down may be varied by changing the relative angularity between the coupling. This is accomplished in the present instance by loosening the bolt 59 and relatively sliding the reduced end portion 58 in or out of the socket portion 57.

The device 54 may be adjusted to be in timed relation with the movement of the guide member 39 so that the change in rate of movement thereof will occur at the point in its change in direction of travel. When used in conjunction with a pump, the setting may be such as to produce a quick return of the plunger on the suction stroke when the pump is of the metering type. When employed in conjunction with a fuel pump the setting may be such as to provide a quick discharge and a retard movement on the suction stroke.

In Fig. 7 I have shown a modified arrangement of crank mechanism which is shown diagrammatically. The guide members 63, 64 in the present instance each comprises a bar 65 having ears 66 formed at each end. The ears 66 have aligned guide openings 67. The bars extend through the axes of rotation thereof and are positioned to extend at right angles to each other. The member 63 has a shaft 68 extending therefrom and is journaled in a fixed bearing 69. The member 64 is provided with a stub shaft 70 extending parallel to shaft 68 and is journaled in a slidably mounted bearing block 71. The block 71 is threadedly engaged by a captive adjusting member 72 provided with an enlarged head portion 73 for manually rotating the same. The shafts may be relatively moved towards or away from each other by rotating the member 72 in the proper direction. The crank pin 74 is provided with right angularly extending rods 75 which are slidably received in guide openings 67. The link for transmitting reciprocating motion from the crank pin to the member 76 which is rectilinearly guided in a bearing 78 is in the present instance in the form of a yoke 79. The yoke has an elongated slot 80 through which the crank pin 74 extends and is also provided with oppositely extending arms 81, 82. The arm 81 is secured to the mem-

ber 76. The arm 82 is also rectilinearly guided in bearing 83.

The operation of the modified crank mechanism is similar to that shown in the other figures of the drawing. Rotary motion may be transmitted to shaft 68 by a device 54 in a manner similar to that above described. As the crank pin 74 is moved the same will reciprocate the yoke 79 and the guided member 76 secured thereto.

The use of the term "plunger" as herein employed is intended to include any such devices which are employed for changing the volume of a pump cylinder and which are reciprocated, for example such as a plunger, piston, or diaphragm.

I claim:

1. A mechanism for converting rotary motion to linear reciprocating motion comprising a link, a guided member attached to said link and reciprocated thereby, means for rotating one end portion of said link in a circular path, and means including a normally stationary member manually operable for shifting the axis about which said link end rotates.

2. A mechanism for converting rotary motion to linear reciprocating motion comprising a link, a guided member attached to said link and reciprocated thereby, means for rotating one end portion of said link in a circular path, and means including a normally stationary member movable independently of the rotation of said link end portion for shifting the axis about which said link end portion rotates.

3. A mechanism for converting rotary motion to linear reciprocating motion comprising a link, a guided member attached to said link and reciprocated thereby, means for reciprocating said link including rotary guide members operatively connected to said link, one end portion of said link rotating in a path intersecting the axes of rotation of said guide members, said guide members rotating about axes movable relative to each other and means for relatively shifting the axes about which said guide members rotate to change the amplitude of reciprocation of said link.

4. A mechanism for converting rotary motion to linear reciprocating motion comprising a link, a guided member attached to said link and reciprocated thereby, means for reciprocating said link including rotary guide members operatively connected to said link, one end portion of said link rotating in a path intersecting the axes of rotation of said guide members, a bearing movably mounted and in which one of said guide members is journaled, and means for moving said bearing for varying the axial spacing between said guide members for shifting the location of the axis about which said end portion of the link rotates.

5. A mechanism for converting rotary motion to linear reciprocating motion comprising a link, a guided member attached to said link and reciprocated thereby, means for oscillating said link including oppositely positioned rotary members rotatable about axes spaced from each other and each having a guide thereon extending at substantially right angles to each other, an intermediate member journaled in said link and slidably engaging said guides and movable relative thereto and rotated thereby in a circular path about an axis extending centrally between the axes of said rotary members.

6. A mechanism for converting rotary motion to linear reciprocating motion comprising a link, a guided member attached to said link and reciprocated thereby, means for rotating one end

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portion of said link including oppositely positioned rotary members rotatable about axes spaced from each other and each having a guide thereon extending at substantially right angles to each other, an intermediate member journaled in said link and slidably engaging said guides and movable relative thereto and rotated thereby in a circular path about a shiftable center extending centrally between the axes of rotation of said rotary members, said intermediate member moving in a path intersecting the axes of rotation of said rotary members, and means for relatively moving said rotary members to and from each other to shift the axis about which said intermediate member rotates.

7. A mechanism for converting rotary motion to linear reciprocating motion comprising a crank mechanism, a guided member attached to said crank mechanism and reciprocated thereby, a constant speed rotary power source, a quick return motion device operatively connected to said power source and crank mechanism for transmitting motion from said power source to said crank mechanism including a pair of shafts extending generally in end-to-end relation and connected to each other by a universal joint, and means for adjusting said device for controlling the rate of travel of the guided member in one direction relative to the other.

8. In a pump, a plunger, a crank motion for reciprocating said plunger comprising rotary guide members, one of said guide members being rotatable about a fixed axis, the other of said guide members being rotatable about an axis movable to and from the said fixed axis, a crank pin slidably mounted on said guide members and movable relative thereto and revolved thereby in a path intersecting the axes of rotation of said guide members, a link operatively connected to said plunger and to said crank pin for transmitting motion from said crank pin to said plunger, and means for moving the movable axis to and from said fixed axis for changing the amplitude of movement of said crank pin.

9. In a pump, a plunger, a crank pin having oppositely spaced guides extending at an angle with each other, a pair of rotating guide mem-

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bers engaging said guides, means for spacing the axes of rotation of said guide members, a link connecting said plunger to said crank pin, a constant speed power source, and a quick return motion device operatively connecting said guide members to said power source.

10. A mechanism for converting rotary motion to linear reciprocating motion comprising a crank mechanism, a guided member attached to said crank mechanism, and reciprocated thereby, a constant speed rotary power source, and a quick return motion device comprising a pair of shafts connected to each other by a universal joint with one of said shafts connected to said power source and the other of said shafts connected to the crank mechanism for transmitting motion from said power source to said crank mechanism.

11. In a pump, a cylinder, a plunger reciprocable in said cylinder, means including a link for reciprocating said plunger in said cylinder, means for rotating one end portion of said link in a circular path, said path passing through a point fixed relative to the end of said cylinder, and means including a normally stationary member manually operable for shifting the axis about which said end rotates whereby the stroke of said plunger is adjusted.

JOHN R. HEFLER.

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