Aug. 31, 1937. R. E. LEONARD 2,091,287

PUMPING POWER

Filed Sept. 4, 1934 2 Sheets-Sheet 1

Fig. 1

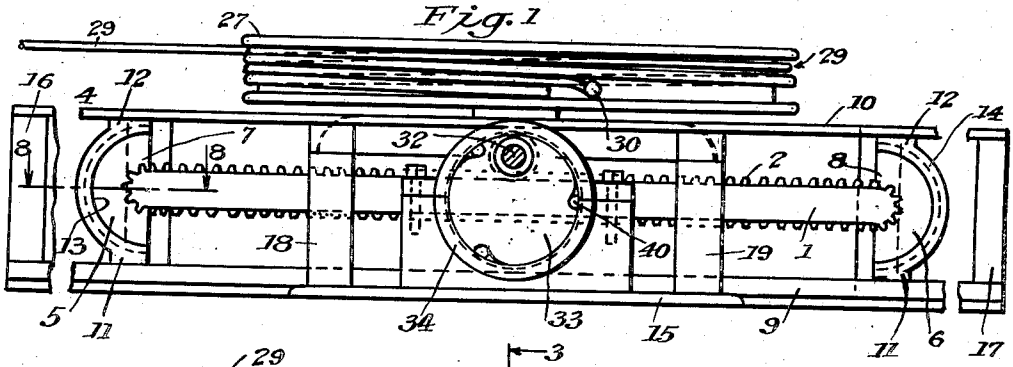


Fig. 2

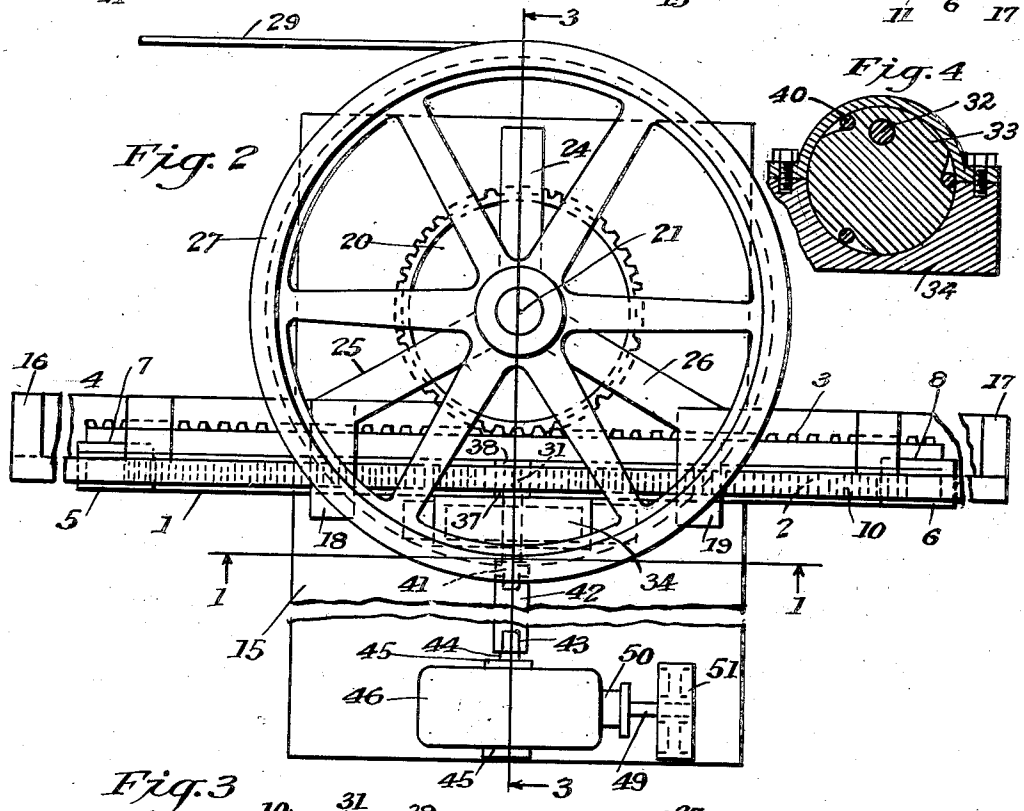
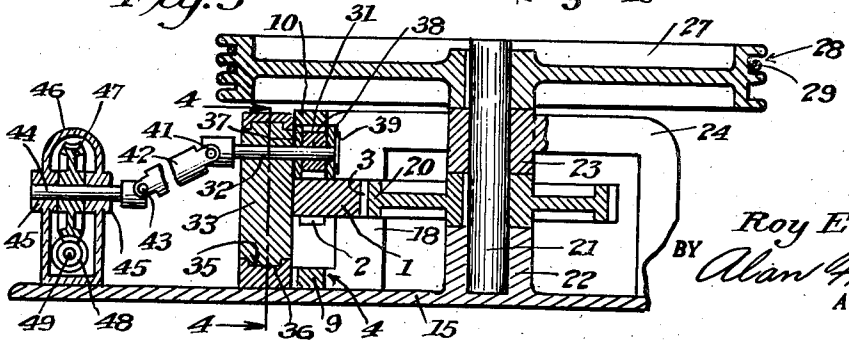


Fig. 4

Fig. 3



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Fig. 5

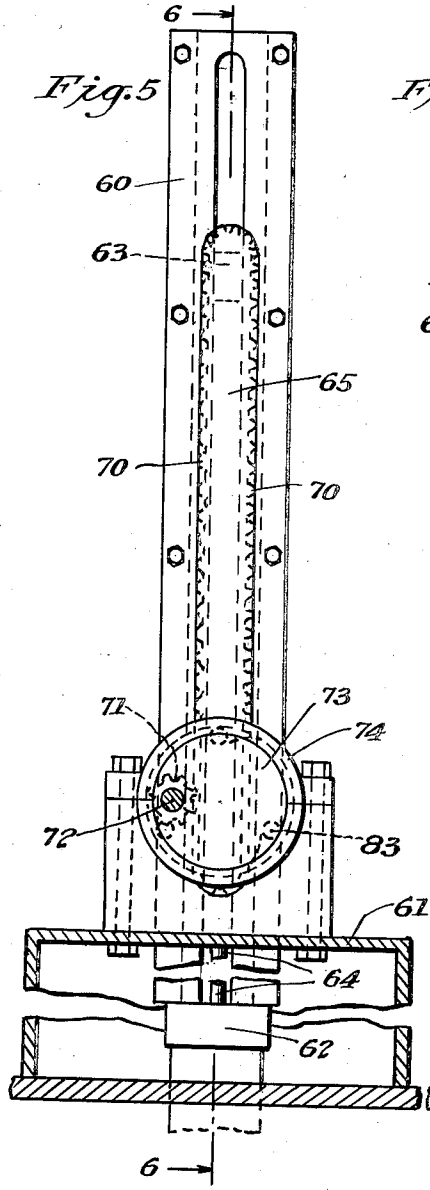


Fig. 6

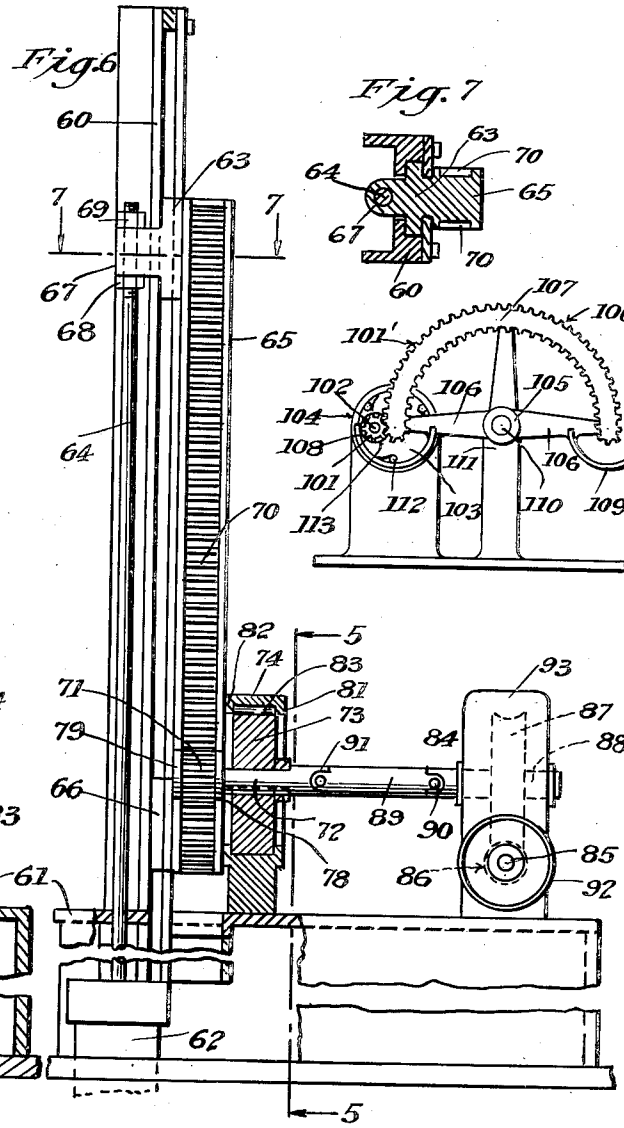
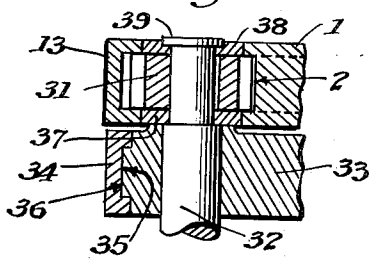


Fig. 7

Fig. 8



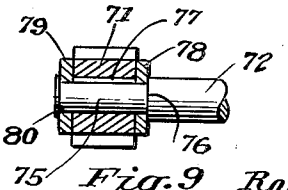


Fig. 9

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PUMPING POWER

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Application September 4, 1934, Serial No. 742,634

7 Claims. (Cl. 74—71)

This invention is a pumping power, particularly useful for operating deep well reciprocating pumps, but may be used for other purposes.

The general object of the invention is to provide a simple, practical and efficient pumping power for effecting a long and slow stroke of the sucker rod of a deep well reciprocating pump.

A more particular object is to provide a pumping power of the character stated including a drive pinion, a double and continuous rack in mesh with said pinion, whereby said rack is reciprocated, and means for enabling said rack to reciprocate the sucker rod of a deep well pump.

Another object is to provide a pumping power including a drive pinion and a rack as above stated, a pull wheel or drum and a pull line extending over and secured to said wheel or drum and means whereby said pull wheel or drum is rotated first in one direction and then in the other by said rack, for enabling said pull line, when connected to the sucker rod of a deep well pump, to reciprocate said rod.

Another object is to provide a power comprising a drive pinion, and a double and continuous segmental gear driven by said pinion first in one direction and then in the other direction.

A further object is to provide a pumping power including a drive pinion and a double and continuous rack in mesh with said pinion, whereby said rack is reciprocated, and means connecting said rack directly to the sucker rod of a deep well pump for enabling said rack to reciprocate said rod.

Other objects and advantages will appear hereinafter.

The invention is illustrated in the annexed drawings which form a part of this specification and in which:

Fig. 1 is a transverse vertical section of one form of my invention taken on line 1—1 of Fig. 2.

Fig. 2 is a plan view of the form of my invention shown in Fig. 1.

Fig. 3 is a vertical longitudinal section taken on line 3—3 of Fig. 2.

Fig. 4 is a transverse vertical section taken on line 4—4 of Fig. 3, illustrating the bearing wheel for the pinion drive shaft, and other features.

Fig. 5 is a transverse vertical section of another form of my invention taken on line 5—5 of Fig. 6.

Fig. 6 is a vertical longitudinal section of the form of my invention shown in Fig. 5 taken on line 6—6 of said figure.

Fig. 7 is a horizontal section taken on line 7—7 of Fig. 6.

Fig. 8 is a section taken on line 8—8 of Fig. 1 with the drive pinion in mesh with the left end of the rack and the drive pinion rollers engaging the left end arcuate pinion guide.

Fig. 9 is a longitudinal section of the drive pinion and guide rollers shown in Figs. 5 and 6, the pinion drive shaft being shown in elevation.

Fig. 10 is a front elevation of another form of my invention.

Corresponding parts are designated by the same reference characters in all the figures of the drawings.

Referring to Figs. 1 to 4 inclusive, 1 designates a rack bar formed with a double continuous rack 2 and with a single rack 3, the rack 2 extending along the upper and lower sides and around the ends of said bar, and the rack 3 extending along the inner side of said bar. The bar 1 is mounted to reciprocate in a slideway 4 by means of cross heads 5 and 6 formed integral with the ends respectively of the bar at 7 and 8, said slideway comprising a lower slide rail 9 and an upper slide rail 10, and said cross heads being formed with lower shoes 11 and upper shoes 12 which slidably engage the upper side of the lower slide rail 9 and the lower side of the upper slide rail 10 respectively. The cross heads 5 and 6 are formed with arcuate pinion guides 13 and 14 spaced from and extending around the ends respectively of the rack 2. The slideway 4 is mounted on a base 15 upon which is secured the lower slide rail 9. The slideway 4 includes end uprights 16 and 17 and intermediate uprights 18 and 19, said end uprights connecting the corresponding ends respectively of the slide rails 9 and 10 and supporting the ends respectively of the slide rails 10 and said intermediate uprights 18 and 19 connecting the slide rails 9 and 10 intermediate their ends and supporting the intermediate portion of the upper slide rail 10. The intermediate uprights 18 and 19 are positioned to engage the front side of the rack bar 1 for guiding said bar and preventing it from being displaced outwardly from the slideway 4. The single rack 3 on the inner side of the rack bar 1 meshes with a gear wheel 20 keyed on a vertical driven shaft 21 journaled at its lower end in a bearing 22 on the base 15 and journaled near its upper end in a bearing 23 on a spider 24 upstanding from said base 1, two of the arms 25 and 26 of said spider being connected to said intermediate uprights 18 and 19 respectively for reinforcing the same.

On the upper end of the driven shaft 21 is

keyed a pull wheel or drum 27, the periphery of which being flanged to form a spiral groove 28 to receive a pull line cable 29, which extends spirally around the periphery of said wheel in said groove and is secured at one end to said wheel as at 30, the other end (not shown) of said cable being connected to an element to be reciprocated, such as the sucker rod of a deep well pump.

A drive pinion 31, in mesh with the double continuous rack 2, is secured on one end of a pinion drive shaft 32 which extends eccentrically through and is journaled in a bearing wheel 33 rotatably mounted in a bearing 34 supported on the base 15 in front of the rack bar 1, said bearing wheel being formed with an external annular flange 35 which is turnably fitted in an internal groove 36 in said bearing 34 to prevent lateral displacement of said bearing wheel with relation to said bearing. Disk rollers 37 and 38 are loosely fitted on the pinion drive shaft 32 adjacent the side faces of the pinion 31, the roller 37 resting between the inner side of the bearing wheel 33 and the adjoining side of said pinion and the roller 31 resting between the opposite side of said pinion and a head 39 on the inner end of the pinion drive shaft 32. The disk rollers 37 and 38 engage the rack bar 1 at the ends of the teeth of the rack 2 and maintain the teeth of the drive pinion 31 and the teeth of the rack 2 in proper meshing relation, so that the pinion and rack will not jam under heavy load, said disks also being positioned to engage the arcuate guides 13 and 14 and guide the pinion 31 around the ends of the rack 2 and maintain the teeth of the pinion in mesh with the teeth of the rack, while the pinion travels around the ends of the rack respectively. A roller clutch 40 is provided in the bearing wheel 33 for engaging the inner surface of the bearing 34 to prevent the wheel from turning clockwise, but allowing the wheel to turn counterclockwise in said bearing for the purpose hereinafter described. The outer end of the pinion shaft 32 is connected by a universal joint 41 to one end of a floating shaft 42 which is connected at its other end by a universal joint 43 to one end of a drive shaft 44 journaled in bearings 45 in a gear housing 46 mounted on the base 15. A worm gear 47 is secured on said drive shaft 44 in mesh with a worm 48 in the lower part of the gear housing 46, which worm is secured on a worm shaft 49 journaled in and extending through a bearing 50 in the lower part of said gear housing. A pulley 51 is secured on the outer end of the worm shaft 49 to which power may be applied.

The operation of my invention as above described, is as follows:

Power being applied to the pulley 51 and said pulley rotated, the drive pinion 31 is rotated clockwise through the medium of the worm shaft 49, worm 43, worm gear 47, drive shaft 44, floating shaft 42, and pinion drive shaft 32, whereupon the drive pinion 31, meshing with the upper side of the rack 2, causes said rack and rack bar 1 to travel to the left (Figs. 1 and 2) and the single rack 3, meshing with the gear 20, rotates said gear, driven shaft 21 and pull wheel or drum 27 in a clockwise direction, which winds the cable 29 on said pull wheel or drum 27 until the drive pinion 31 reaches the right end of the rack 2, during which operation the disk rollers 37 and 38 engage the upper side of the rack bar 1 and maintain the drive pinion in proper meshing relation with the upper side of the rack 2. As the cable 29 is wound on the drum 27, the sucker rod of a deep well pump, to which rod said cable is connected, is lifted slowly for a distance equal to the length of that portion of the cable which is wound on said drum. As the drive pinion 31 reaches the right end of the rack 2 the rollers 37 and 38 engage the arcuate guides 14 and the end of the rack bar 1, and said pinion is thereby guided downwardly around the right end of the rack; and since the roller clutch 40 prevents rotation of the bearing wheel 33 clockwise, the movement of the pinion 31 around the right end of the rack 2 causes said bearing wheel to rotate counterclockwise and give the rack bar 1 an additional movement to the left equal to the distance between the center of the bearing wheel 33 and the center of the drive pinion 31, which additional movement of the rack bar 1 gives the pull wheel or drum 27, through the rack 3, gear 20, and driven shaft 21, a corresponding additional clockwise movement, and said additional movement of the pull wheel or drum 27 winds an additional length of the cable 29 on said drum and lifts the sucker rod to which said cable is connected a corresponding additional distance, thus increasing the length of the upward stroke of said sucker rod. As the drive pinion 31 travels around the right end of the rack 2, the bearing wheel 33 is rotated 180° counterclockwise and said pinion then engages the lower side of the rack 2 and causes said rack and the rack bar 1 to travel to the right, until said pinion reaches the left end of said bar, the disk rollers 37 and 38 engaging the under side of the rack bar 1 and maintaining the pinion 31 in proper mesh with said under side of said rack, during which operations, the pull wheel or drum 27, through the medium of the rack 3, gear 20 and driven shaft 21, is rotated counterclockwise, and the cable 29 is unwound from said drum, and the sucker rod, to which said cable is connected, is allowed to descend a distance equal to the length of the cable which is unwound from said drum. As the drive pinion reaches the left end of the rack 2, the pinion rollers 37 and 38 engage the arcuate guide 13 and the end of the rack bar 1, and said pinion is thereby guided upwardly around the left end of the rack, during which operation the roller clutch 40 prevents the bearing wheel 33 from rotating clockwise, but allows said wheel to rotate counterclockwise, which gives the rack bar 1 an additional movement to the right equal to the distance between the center of the bearing wheel 33 and the center of the drive pinion 31, whereupon the pull wheel or drum 27, through the rack 3, gear 20 and driven shaft 21, is given a corresponding additional counterclockwise movement, which movement of the drum 27 unwinds therefrom an additional length of the cable 29 and allows the sucker rod, which is connected to said cable, to descend a corresponding additional distance, thus increasing the downward stroke of the sucker rod. As the drive pinion 31 travels around the left end of the rack 2 the bearing wheel 33 is rotated 180° counterclockwise and said pinion then engages the teeth on the upper side of the rack at the left end thereof, and the above described operations are then repeated, giving the sucker rod a slow stroke of maximum length.

In the form of my invention illustrated in Figs. 5 to 7 and 9 inclusive, a vertical slideway 60 is mounted in a base 61 above the upper end of the casing 62 of an oil well, and a slide 63 is mounted to slide in said slideway, which slide is connected to the upper end of the sucker rod 64 of said oil

well, and to the upper end of a vertical rack bar 65, the lower end of said rack bar being connected to a slide 66 also mounted to slide in said slideway. The upper end of said sucker rod 64 extends through a lug 67 projecting from the slide 63 and nuts 68 and 69, in threaded engagement with said rod, engage the lower and upper sides respectively of said lug for detachably connecting the upper end of said sucker rod to the slide 63. A double continuous rack 70 extends along opposite sides of the rack bar 65 and around the lower and upper ends of said bar, which rack meshes with a drive pinion 71 keyed on one end of a pinion drive shaft 72 journaled in a bearing wheel 73, which bearing wheel is journaled in a bearing 74 mounted on the base 61. The drive pinion shaft 72 is reduced from its inner end for a portion of its length as at 75, providing a shoulder 76 between said reduced portion and the remainder of said shaft, and the drive pinion 71 is keyed by a key 77 on said reduced portion of said shaft, while a pair of disk rollers 78 and 79 are turnably mounted on said reduced shaft portion at the outer and inner sides respectively of said drive pinion 71, the roller 78 fitting between the outer side of said pinion and the shoulder 76 and the inner end of the reduced portion 75 of the pinion drive shaft 72 being flanged over the inner side of the roller 79, as at 80, for holding the roller 78, drive pinion 71 and roller 79 in operative position on said reduced portion 75 of the pinion drive shaft, so that said rollers 78 and 79 will engage the sides and ends of the rack bar 65 at opposite sides of the drive pinion 71 while said pinion meshes with the rack 70. The bearing 74 is formed with internal annular flanges 81 and 82 at opposite sides respectively of the bearing wheel 73 for preventing displacement of said bearing wheel from said bearing. A roller clutch 83 is provided in the periphery of the bearing wheel 73 for clutching said bearing wheel with the bearing 74, to prevent turning of said bearing wheel counterclockwise, but allowing said bearing wheel to turn clockwise in said bearing.

Power is applied through a transmission mechanism 84, which comprises a worm shaft 85, a worm 86 secured on said worm shaft, a worm gear 87 in mesh with said worm, a drive shaft 88 on which said worm gear is secured, and a floating shaft 89 connected at one end by a universal joint 90 to one end of said drive shaft 88, and connected at its other end by a universal joint 91 to the outer end of the pinion drive shaft 72, there being a pulley 92 secured on the outer end of the worm shaft 85 to which power is applied to drive said worm shaft. The worm shaft 85 and the drive shaft 88 are journaled in a gear housing 93 which encloses the worm 86 and the worm gear 87.

The operation of my invention shown in Figs. 5 to 7 and 9 inclusive is as follows:

Power being applied to the pulley 92 to rotate the same, the drive pinion 71 is rotated counterclockwise, through the medium of the worm shaft 85, worm 86, worm gear 87, drive shaft 88, universal joint 90, floating shaft 89, universal joint 91 and drive pinion shaft 72, whereupon the drive pinion 71 meshing with the rack 70 at the left side of the rack bar 65 causes said bar and the sucker rod 64 to move upwardly, until the lower end of said bar approaches said drive pinion, and as said pinion travels around the lower end of said rack, the roller clutch 83 prevents rotation of the bearing wheel 73 counterclockwise, but allows said wheel to rotate clockwise, which causes said drive pinion 71 to move the rack bar 65 and sucker rod 64 upwardly an additional distance equal to the distance between the center of the bearing wheel 73 and the pinion shaft 72, thus increasing the upward stroke of the rack bar 65 and sucker rod 64. When the drive pinion 71 has traveled around the lower end of the rack 70 it meshes with the teeth on the right side of the rack bar 65 and causes said bar and the sucker rod 64 to descend, until the upper end of the rack reaches said drive pinion, and as said drive pinion travels around the upper end of the rack 70, the roller clutch 83 prevents rotation of the bearing wheel 73 counterclockwise, but allows said wheel to rotate clockwise, which causes the drive pinion 71 to move the rack bar 65 and sucker rod 64 downwardly an additional distance equal to the distance between the center of the bearing wheel 73 and the center of the pinion shaft 72, thus increasing the downward stroke of the sucker rod 64. When the drive pinion 71 has traveled around the upper end of the rack 70 it again meshes with the rack at the left side of the rack bar 65 and the above described operations are repeated.

In the form of my invention shown in Fig. 10 a double continuous segmental gear 100 meshes with a drive pinion 101 secured on a drive shaft 102 journaled in a bearing wheel 103, which bearing wheel is journaled in a bearing 104. The segmental gear 100 comprises a hub 105, spokes 106 radiating from said hub, and a segmental annulus 107 secured on the ends of said spokes, said annulus being formed with gear teeth 101' on its inner and outer sides and around its ends which mesh with the teeth of said drive pinion. Arcuate guides 108 and 109 are secured on spokes 106 of the segmental gear 100 and extend around the ends respectively of said gear for guiding the pinion around said ends for reversing the movement of said gear. The hub 105 of the segmental gear 100 is secured on a driven shaft 110 journaled in a bearing 111. A roller clutch 112 is provided between the bearing wheel 103 and the bearing 104 for preventing rotation of said wheel in one direction while allowing said wheel to rotate in the other direction. Power may be applied to rotate the pinion drive shaft through a transmission such as the transmission 84 shown in Fig. 6. Rollers 113 are journaled on the pinion drive shaft 102 for engaging the arcuate guides 108 and 109 for guiding the pinion around the ends of the segmental gear 100. Power may be applied from the driven shaft 110 in any suitable manner.

I claim as my invention:

1. In combination, a double continuous rack, a pinion in mesh with said rack, means for enabling said pinion to travel around the ends of said rack from one side thereof to the other for reciprocating said rack and means for shifting said pinion as it travels around the ends of said rack for increasing the movement of said rack.

2. In combination, a double continuous rack, a bearing wheel, a pinion shaft journaled eccentrically in said bearing wheel, means for rotating said pinion shaft, a pinion on said pinion shaft in mesh with said rack, and means for preventing rotation of said bearing wheel in one direction, but allowing rotation of said wheel in the other direction to enable said pinion to travel around the ends of said rack and increase the movement of said rack.

3. In combination, a double continuous rack, a bearing wheel, a pinion shaft journaled eccentrically in said bearing wheel, a pinion on said

pinion shaft in mesh with said rack, a drive shaft, means whereby said drive shaft is rotated, a floating shaft universally connected at its ends respectively to said drive shaft and said pinion shaft, and means for preventing rotation of said bearing wheel in one direction, but allowing rotation thereof in the other direction to enable said pinion to travel around the ends of said rack and increase the movement of said rack.

4. In combination, a rack bar, a rack extending along opposite sides and around the ends of said rack bar, means for mounting said rack bar to reciprocate vertically over a deep well, means connecting said rack bar to the sucker rod of a pump in said well, a pinion in mesh with said rack, and means for enabling said pinion to travel around the ends of said rack from one side thereof to the other for reversing the movement of said rack and said sucker rod and means for shifting said pinion as it travels around the ends of said rack and bar for increasing the movement of said rack bar and sucker rod.

5. In combination, a pinion for driving racks or segmental gears, a pinion shaft, a bearing wheel in which said pinion shaft is eccentrically journaled, means for preventing rotation of said bearing wheel in the direction of travel of said pinion, but allowing rotation thereof in the opposite direction, and means for rotating said pinion shaft and pinion.

6. In combination, a rack bar, a rack extending along opposite sides and around the ends of said rack bar, a second rack extending along a third side of said rack bar, means for reciprocatively mounting said rack bar, a pinion in mesh with said first rack, means for enabling said pinion to travel around the ends of said first rack from one side thereof to the other for reciprocating said rack, a gear-wheel shaft, a gear wheel secured on said gear-wheel shaft in mesh with said second rack, a drum secured on said gear-wheel shaft, and a cable connected at one end to said drum and wound thereon.

7. In combination, a rack bar, a rack extending along opposite sides and around the ends of said rack bar, a second rack extending along a third side of said rack bar, means for reciprocatively mounting said rack bar, a pinion in mesh with said first rack, means for enabling said pinion to travel around the ends of said first rack from one side thereof to the other for reciprocating said rack, means for shifting said pinion as it travels around the ends of said first rack to increase the movement of said rack, a gear-wheel shaft, a gear wheel on said gear-wheel shaft in mesh with said second rack, a drum secured on said gear-wheel shaft, and a cable connected at one end to said drum and wound thereon.

ROY E. LEONARD.