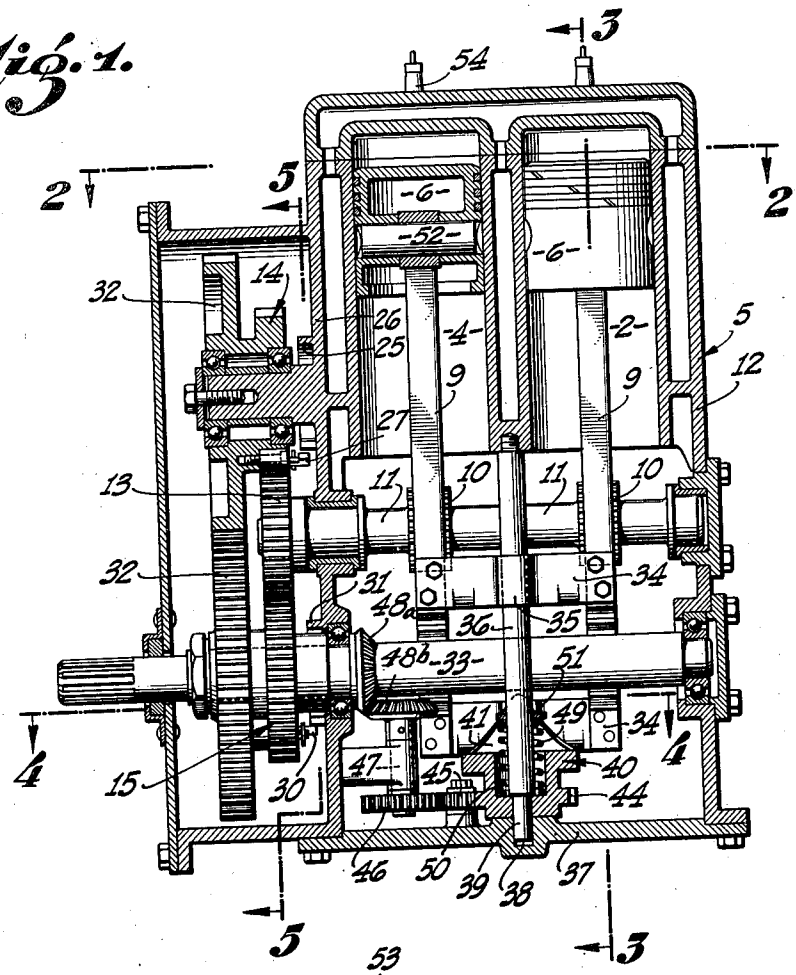
Dec. 21, 1943. Z. J. JULIN 2,337,330

DRIVING MECHANISM

Filed Aug. 25, 1942 3 Sheets-Sheet 1

Fig. 1.



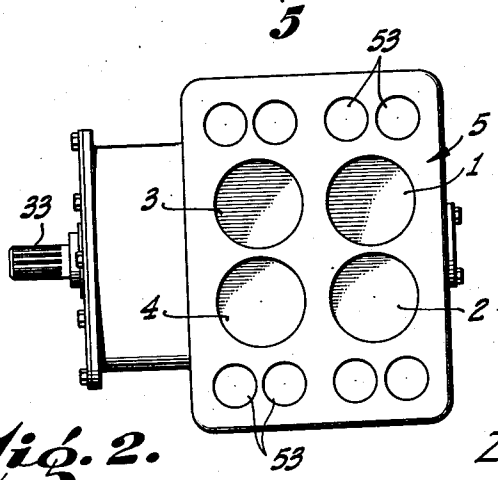


Fig. 2.

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DRIVING MECHANISM

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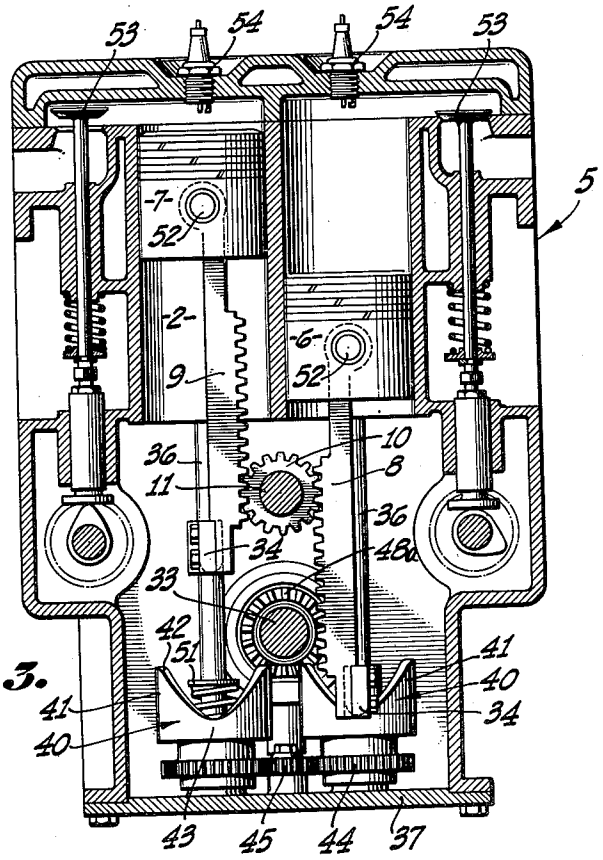


Fig. 3.

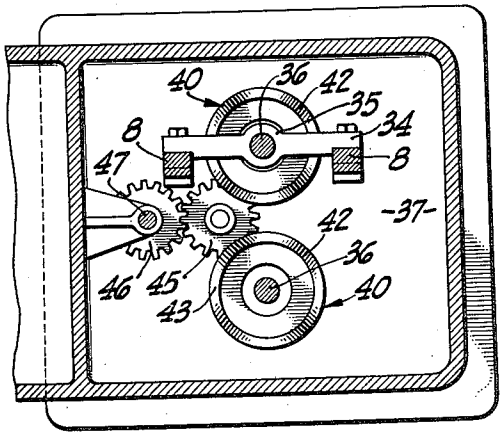


Fig. 4.

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DRIVING MECHANISM

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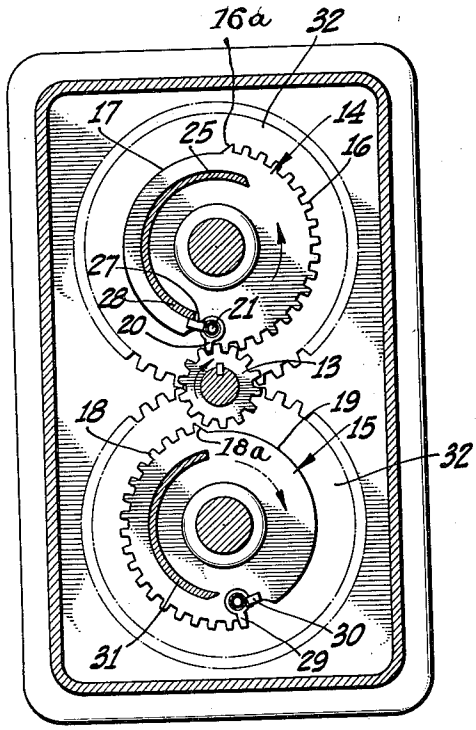


Fig. 5.

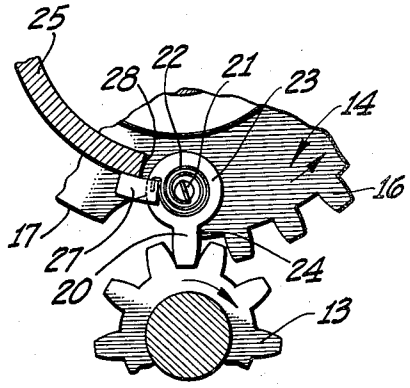


Fig. 6.

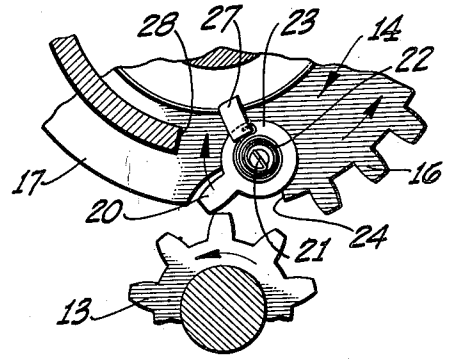


Fig. 7.

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UNITED STATES PATENT OFFICE

2,337,330

DRIVING MECHANISM

Zeniph J. Julin, Los Angeles, Calif.

Application August 25, 1942, Serial No. 455,995

13 Claims. (Cl. 74—29)

This invention relates to mechanism for translating a reciprocating movement into a continuous rotary movement constantly in the same direction, but, if desired, the translation may be reversed—that is to say, from a rotary motion of a shaft to a reciprocating motion of a machine part.

While there are many situations in which this improvement can be utilized, in the present specification, the invention is described as applied to a motor having power cylinders with reciprocating pistons, and the mechanism illustrated provides means for translating the reciprocating motion of the pistons into a continuous rotation of the driven shaft constantly in one direction.

The ordinary means for translating a reciprocating movement into a rotary motion of a shaft involves the use of a crank on a shaft and a connecting rod attached to the shaft at one end and attached to the reciprocating part of the piston at the other end. One of the objections to the use of a crank for transmitting the power to the shaft is that in most motors operating with fluid pressure the fluid exerts its maximum pressure when the piston is at the end of its stroke and moving away from the adjacent cylinder head. At this instant, the crank is nearly on dead center and hence the effective crank arm is practically nothing at the start of the stroke, and, although it gradually increases toward mid-stroke, as this occurs the pressure upon the piston is gradually falling. This objection is particularly aggravated in internal explosion engines, such as ordinary four-cycle engines, because when the explosion occurs and the maximum pressure is developed the crank is practically on dead center.

One of the objects of the present invention is to provide mechanism for translating the reciprocating motion into a rotary motion of a driven shaft constantly rotating in the same direction; particularly to provide simple means for utilizing the force exerted by reciprocating pistons in such a way that the driving force exerted by them will be transmitted to the driven shaft with a constant crank arm, as it were; that is to say, means is provided for developing torque in a shaft driven by the reciprocating pistons in such a way that virtually a crank arm of constant radius is maintained.

A further object of the invention is the provision of means for resisting and stopping the motion of the reciprocating parts at the end of their out-stroke; also to provide for accomplishing this effect in such a way that the momentum of the piston and associated parts that move with it is utilized to impart an accelerating force to the driven shaft.

In its preferred embodiment, the invention involves the use of a driving pinion which is located between two segmental gear-wheels presenting two toothed segments that mesh with the pinion. The two segmental gear-wheels are maintained in motion constantly in the same direction; that is to say, each segmental gear-wheel constantly rotates in one direction. The pinion meshes alternately with the segments of the two segmental gear-wheels, and one of the objects of the invention is to provide a construction which will effect the disengagement of the pinion from its mesh with one of the segments when the drive of the pinion to the other segment commences.

Further objects of the invention will appear hereinafter.

The invention consists in the novel parts and combinations of parts to be described hereinafter, or which contribute to produce an efficient driving mechanism.

A preferred embodiment of the invention is described in the following specification, while the broad scope of the invention is pointed out in the appended claims.

In the drawings:

Figure 1 is a longitudinal vertical section taken substantially in a vertical plane passing through the axis of the driven shaft, certain parts in this plane, however, being shown in elevation.

Figure 2 is a plane on a reduced scale of the cylinder block and some associated parts, with the engine cover removed so as to illustrate the cylinder and valve arrangement.

Figure 3 is a vertical section taken about on the line 3—3 of Figure 1.

Figure 4 is a horizontal section taken about on the line 4—4 of Figure 1, and particularly illustrating the means for absorbing the momentum of the piston and associated parts at the end of their out stroke, and showing the means for utilizing the force developed in doing this to accelerate the driven shaft.

Figure 5 is a section taken about on the line 5—5 of Figure 1. This view illustrates the relation of the driving pinion to the two segmental gears that it meshes with alternately and each of which it drives in the same direction.

Figure 6 is a fragmentary detail view illustrating the relationship of the parts associated with the movable tooth at the end of the drive to a segmental gear-wheel carrying it. This view

shows the tooth about to be released by the cam so that it can be moved down out of the way when the driving pinion reverses its direction of rotation.

Figure 7 is a view similar to Figure 6, but showing these parts in a later phase of their operation and after the reversal of the pinion has occurred. In this phase the tooth 20 is shown moving to the left and out of the path of the teeth of the driving pinion 13.

Referring more particularly to the parts in the present specification, 1, 2, 3, and 4 indicate the power cylinders in the cylinder block 5. As illustrated in Figure 3, these power cylinders operate in pairs. These cylinders are provided, respectively, with reciprocating pistons 6 and 7, to which racks 8 and 9 are attached, said racks having teeth on their adjacent faces to mesh with the opposite sides of a pinion 10 that is rigidly mounted on a driving shaft 11. The ends of this driving shaft 11 are mounted in the engine housing 12, and one end of the shaft is provided with a driving pinion 13. As the piston 6 descends, of course, the piston 7 rises in its cylinder, and as the pistons reciprocate the driving pinion 13 is alternately rotated in opposite directions. The means for translating this alternate rotation into a constant rotation in one direction involves the use of two segmental gear-wheels 14 and 15 (see Figures 1 and 5). The upper gear 14 has projecting teeth extending around a portion of its periphery so as to form a segment 16, and the remaining portion of the periphery of this gear-wheel is blank; that is to say, it presents a depressed peripheral edge 17 that is on a radius located at or about the root of the teeth of the segment. The segmental gear 15 is constructed similar to this; that is to say, it has a similar segment 18 of projecting teeth extending on a portion of its periphery and also a depressed peripheral edge 19 located at or within the root circle of this gear. In the operation of the mechanism, these segments are driven alternately by the teeth of the driving pinion 13. In Figure 5 this gearing is illustrated just at the termination of the drive to the upper segmental gear-wheel 14 and just before the instant when the drive of the driving-pinion 13 reverses to the anti-clockwise direction, indicated by the arrow shown in dotted lines. In order to enable the teeth of the pinion 13 to become released from the teeth of the segment 16 at this moment, the last tooth 20 of the segment 16 is movably attached to the body of the gear-wheel 14. This tooth normally occupies an upright position so as to operate as a regular tooth of the segment 16. This tooth 20 is preferably pivotally mounted on the body of the gear-wheel 14 by means of a pivotal connection 21, and I prefer to provide a coil spring 22 disposed around the axis of this pivotal connection and connected with the hub 23 of the tooth so as to normally hold this tooth in its operating position and against a stop shoulder 24 (see Figure 7).

In order to prevent an accident in case this spring 22 should break, I prefer to provide other means for maintaining the last tooth or dog 20 in this extended position during the period of rotation of the gear-wheel 14 during which the pinion 13 is driving this gear-wheel. For this purpose, I provide a fixed cam 25 which is mounted on the wall 26 of the housing (see Figure 1), and the hub 23 of the movable tooth 20 has an outwardly projecting finger 27 that rides along the outer face of this cam, eventually arriving at the end 28 of this cam, at which point the cam will permit the tooth 20 to swing inwardly in the direction of the arrow in Figure 7. Just as the finger 27 passes the end 28 of the cam, the pinion 13 reverses its direction of motion, and when this occurs the teeth of this pinion push the tooth 20 to one side. As the rotation of the gear-wheel 14 continues, the blank face 17 passes along adjacent to the ends of the teeth of the pinion, but with sufficient clearance to prevent the same from contacting with the pinion's teeth. This mode of operation is fully illustrated in Figures 6 and 7.

The gear-wheel 15 is provided with a pivoted tooth 29, similar to the tooth 20 just described, and mounted in the same way with its own spring, similar to the spring 22, and with its own radially projecting finger 30 to cooperate with its own cam 31. This tooth 29 will operate in the manner just described when the tooth 29 comes into engagement with the teeth of the pinion 13 and when the next reversal of motion of the pinion 13 occurs.

The two segmental gear-wheels 14 and 15 are connected for rotation in synchronism and, of course, they rotate at the same speed. For this purpose, each of these gear-wheels is connected rigidly to a gear-wheel 32, and these two gear-wheels 32 mesh together. The lower gear-wheel 32 is rigid on the driven shaft 33, which is mounted for rotation in suitable bearings in the engine housing.

In addition to the opposite pairs of cylinders 1 and 2, the pistons of which move in opposite directions at the same time, the pistons are connected together in pairs in another way, as illustrated in Figure 1. In other words, there is a pair of cylinders located on each side of the shaft 11, each pair of cylinders cooperating with its own pinion 10 on this shaft.

A means will now be described for absorbing the momentum of each of these pairs of pistons as they arrive at the lower end of their downstroke. For this purpose, the backs of the racks 8 and the backs of the racks 9 are provided with rigid cross-heads 34, respectively, the middle portions of which are formed into guide sleeves 35 guided on guides 36, respectively. Each of these guides 36 is in the form of a round bar that extends down to the engine base plate 37, in which it is stepped in a socket 38. At this point, a reduced neck 39 is formed on the guide bar 36, which operates as a shaft or arbor for a rotary cam 40. This cam is in the form of a wheel having two upwardly projecting diametrically disposed cam horns 41. These horns present cam faces 42 extending up from a rudimentary socket 43 at each side of the wheel. There is, of course, a cam wheel 40 corresponding to each of these pairs of pistons, and these cam wheels are geared up to the driven shaft 33 so that they rotate in synchronism with the shaft 33. For this purpose, the lower portion of each cam wheel 40 is formed into a gear-wheel 44 that meshes with an idler pinion 45 driven by gear-wheel 46 on the lower end of a vertical countershaft 47, driven by bevelled gears 48a and 48b from the shaft 33. When the engine is in operation, as each cross-head 34 descends, its under side strikes a pair of diametrically opposed cam faces 42 of the cam wheel 41 located on the rear sides of the horns with respect to their direction of rotation. This engagement of the cross-heads with these cam faces, of course, resists the downward movement of the cross-heads and eventually stops their downward movement. At the same time, the ab-

sorbing of the momentum of the cross-heads, racks, and attached pistons develops a torque force on the cam wheels to accelerate their rotation in the driving direction.

In order to assist in absorbing the momentum of the cross-heads and to assist in starting them up again after they have reached the bottom of their stroke, I prefer to provide cushioning means associated with each guide bar **36**. This cushioning means in the present instance consists of a stout helical spring **49**, the lower end of which is housed in a spring socket **50** on the axis of the cam wheels and the upper end of which supports a sliding collar **51** on the guide bar **36**. When this collar **51** is struck by the sleeve **35** of its corresponding cross-head, it will be moved down the bar **36** and will, of course, compress the spring **49**. This compression built up in the spring will be greatly increased at the end of the stroke where the force of the spring will exert itself to accelerate the cross-head **34** in an upper direction.

The upper ends of the racks **9** operate as piston rods, and I prefer not to attach them rigidly to their pistons, but to employ a wrist pin **52** at this point similar in construction to the ordinary wrist pin that is employed for connecting an ordinary connecting rod to such a piston.

In the power cylinder engine, such as illustrated, the valves **53** and the ignition at the spark plugs **54** would be controlled in such a way that the cylinders would fire, as in an ordinary four-cycle engine. In other words, as two pistons on the same side of the shaft are descending, one of the pistons would be drawing in the charge while the other cylinder would be exploding its charge. On the up-stroke of these two pistons, the charge will be compressed in one of them while the other one will be exhausting.

In the design of the segment teeth and their movable teeth **20** and **29**, the pitch of the teeth should be sufficient to insure that when the reversal of the drive occurs the regular teeth of the segment that have just been driven by the pinion will have moved out of the path of the teeth of the pinion so as to insure that the pinion can not re-engage the segment from which it has just become released.

The first tooth of each of the segments **16** and **18** should be cut away to an inclined face **16***a* and **18***a* respectively for clearance purposes so as to prevent this first tooth from meshing into the pinion at the wrong place.

The ratios of the pinions **10**, **13** and **15**, should be such that the stroke of the pistons is substantially equal to the diameter of the gear **15**. By selecting the proper ratio for the diameter of pinions **10** and **13**, the piston stroke may be made as small or as large as desired.

The cam wheels **40** should rotate at exactly the same speed as the shaft **33**, and consequently the bevel gears **48***a* and **48***b* should be of the same diameter.

The springs **49** prevent the pistons from ever stopping at the end of their stroke when the engine is throttled down to stop and assure that the pinions **10** will never turn backward when they should be turning forward.

Many other embodiments of the invention may be resorted to without departing from the spirit of the invention.

What I claim is:

1. In mechanism of the kind described, the combination of a driving-shaft, means for driving the same alternately in different directions, a driving-pinion on said shaft, a segmental gear-wheel having a blank portion throughout a portion of its periphery and having a toothed segment projecting beyond the path of the periphery of the blank portion throughout another portion of the periphery of the gear-wheel, and meshing with the pinion while it is rotating in one direction, a second segmental gear-wheel driven in synchronized rotation with the first-named segmental gear-wheel, also having a blank portion and a projecting toothed segment extending around a portion of its periphery, so that its segment meshes with the pinion while the pinion is rotating in the other direction, means associated with the toothed segments of the gear wheels for effecting disengagement of the pinion from each of said segments when the other segment commences to mesh with the said pinion; a driven shaft, and means driven by the said gear wheels for driving the driven-shaft continuously in one direction.

2. In mechanism of the kind described, the combination of a driving-shaft, means for driving the same alternately in different directions, a driving-pinion on said shaft, a segmental gear-wheel having a blank part throughout a portion of its periphery and having a toothed segment projecting beyond the path of the periphery of the blank part throughout another portion of the periphery, and meshing with the pinion while it is rotating in one direction, a second gear-wheel driven in synchronized rotation with the first-named gear-wheel, also having a blank portion and a projecting toothed segment, extending around a portion of its periphery and meshing with the pinion while the pinion is rotating in the other direction, the last tooth of each of said segments to be in engagement with the pinion when the same is driving that gear-wheel consisting of a pivoted tooth mounted on the body of the gear-wheel, and operating upon reversal of the direction of drive of the pinion, to rotate on its pivot and thereby effect disengagement of the pinion from that toothed segment so as to permit the other segment to engage the pinion and continue the drive; a driven shaft, and means driven by the said gear-wheels for driving the driven shaft continuously in one direction.

3. In mechanism of the kind described, the combination of a driving-shaft, means for driving the same alternately in different directions, a driving-pinion on said shaft, a segmental gear-wheel having a blank part throughout a portion of its periphery and having a toothed segment projecting beyond the path of the periphery of the blank part throughout another portion of the periphery, and meshing with the pinion while it is rotating in one direction, a second gear-wheel driven in synchronized rotation with the first-named gear-wheel, also having a blank portion and a projecting toothed segment, extending around a portion of its periphery and meshing with the pinion while the pinion is rotating in the other direction, the last tooth of each of said segments to be in engagement with the pinion when the same is driving that gear-wheel, consisting of a tooth movably mounted on each segmental gear-wheel body and operating upon reversal of the direction of drive of the pinion, to move inwardly into a depressed position to disengage itself and its segment from the pinion, thereby permitting the other segment to continue the drive when the pinion commences to mesh with the other segment; a driven shaft, and means driven by the said segmental gear-wheels

for driving the driven shaft continuously in one direction.

4. In mechanism of the kind described, the combination of a driving-shaft, means for driving the same alternately in different directions, a driving-pinion on said shaft, a segmental gear-wheel having a blank part throughout a portion of its periphery and having a toothed segment projecting beyond the path of the periphery of the blank part throughout another portion of the periphery, and meshing with the pinion while it is rotating in one direction, a second gear-wheel driven in synchronized rotation with the first-named gear-wheel, also having a blank portion and a projecting toothed segment, extending around a portion of its periphery and meshing with the pinion while the pinion is rotating in the other direction, the last tooth of each of said segments to be in engagement with the pinion when the same is driving that gear-wheel, consisting of a pivoted tooth mounted on the body of each segmental gear-wheel, resilient means normally holding each pivoted tooth in an upright operative position, each pivoted tooth operating upon reversal of the direction of drive of the pinion, to rotate on its pivot into a depressed position, and thereby effect disengagement of itself and its segment from the pinion, thereby permitting the other segment to continue to drive when the pinion commences to mesh with the other segment; a driven shaft, and means driven by the said gear-wheels for imparting their rotation to the driven shaft continuously in one direction.

5. In mechanism of the kind described, the combination of a driving-shaft, a pinion mounted on the driving-shaft, a pair of racks mounted one on each side of the pinion and meshing with the same, means for reciprocating the racks to drive the driving-shaft alternately in opposite directions, a driving-pinion on said driving-shaft, a segmental gear-wheel having a blank portion throughout a portion of its periphery and a toothed segment throughout another portion of its periphery projecting beyond the path of the periphery of the blank portion, said segment meshing with the last-named pinion while it is rotating in one direction; a second gear-wheel in synchronized rotation with the first-named segmental gear-wheel having a blank portion, and a projecting toothed segment extending around a portion of its periphery and meshing with the last-named pinion while the same is rotating in the other direction, the last tooth of each segment with respect to the direction of rotation being pivoted and operating upon reversal of the direction of drive of the driving-pinion, to rotate on its pivot and thereby disengage itself and its segment from the driving-pinion so as to permit the other segment to continue the drive when the driving-pinion commences to mesh with the other segment; a driven shaft, and means driven by the said gear-wheels for driving the driven shaft continuously in one direction.

6. In mechanism of the kind described, the combination of a pair of power cylinders, a piston in each cylinder, a rack reciprocated by each piston, a pinion, located between the racks and rotated alternately by the same in opposite directions, a driving-pinion on said shaft, a driven shaft, means cooperating with said driving-pinion for driving the driven shaft continuously in one direction, rotatable means for absorbing the momentum of each rack and piston and stopping the same at the end of their stroke, and means associated with the last-named means for imparting a torque impulse from said rotatable means to the driven shaft.

7. In mechanism of the kind described, the combination of a pair of power cylinders, a piston in each cylinder, a rack reciprocated by each piston, a pinion, located between the racks and rotated alternately by the same in opposite directions, a driving-pinion on said shaft, a driven shaft, means cooperating with said driving-pinion for driving the driven shaft continuously in one direction, a rotatable cam-wheel, means moving with the rack for engaging the cam-wheel and developing torque therein, said cam-wheel operating to absorb the momentum of the rack and piston and stop the same at the end of their stroke; and means for transmitting the said developed torque to the driven shaft.

8. In mechanism of the kind described, the combination of a pair of power cylinders, a piston in each cylinder, a rack reciprocated by each piston, a pinion, located between the racks and rotated alternately by the same in opposite directions, a driving-pinion on said shaft, a driven shaft, means cooperating with said driving-pinion for driving the driven shaft continuously in one direction, a cross-head moving in unison with the rack and piston, a cam-wheel having a pair of cam faces in a position to be engaged by the cross-head as the piston and rack approach the end of their stroke, means connecting the cam-wheel to the driven shaft to synchronize the rotation of the cam-wheel with the driven shaft, and so that the impact of the advancing cross-head on the said cam faces develops torque therein urging the same forward in the driving direction.

9. A mechanism constructed as described in claim 8, in which a resilient cushion is provided for absorbing the momentum of the piston and rack, and for preventing the pinion from ever rolling backwards at the end of the stroke.

10. In mechanism of the kind described for imparting rotary motion constantly in the same direction to a driven shaft from a driving-shaft driven alternately in opposite directions, the combination of a pair of parallel shafts, a gear-wheel on each of the shafts, of equal diameter meshing together so as to rotate said shafts continuously in synchronism in opposite directions, a segmental gear-wheel mounted to rotate on the axis of each of said shafts, having a segment of projecting teeth extending substantially half-way around the periphery and having a depressed blank portion substantially filling the remainder of the periphery of the segmental gear wheel, a driving-pinion on the driving-shaft located between the two synchronized shafts meshing with the teeth of said segments alternately, the last tooth of each of said segments with respect to the direction of rotation having a pivot connection to the body of its segmental gear, said segmental gears being oriented with respect to each other so that at the instant of reversal of direction of the driving-pinion one of said segments passes out of engagement with the pinion, and the other segment passes into engagement with the pinion, the said pivoted teeth operating to swing out of engagement with the teeth of the pinion as the reversal of direction of rotation of the pinion occurs, so as to disconnect the teeth of the segment that is just completing its driven movement, as the pinion commences to make engagement with the teeth of the other segment.

11. In mechanism of the kind described, the combination of a driving-shaft, means for driving the same alternately in different directions, a driving pinion on said shaft, a segmental gear-wheel having a blank portion throughout a portion of its periphery and having a toothed segment projecting beyond the path of the periphery of the blank portion throughout another portion of the periphery of the gear-wheel, and meshing with the pinion while it is rotating in one direction, a second segmental gear-wheel driven in synchronized rotation with the first named segmental gear-wheel, also having a blank portion and a projecting toothed segment extending around a portion of its periphery, so that its segment meshes with the pinion while the pinion is rotating in the other direction, means mounted on each of said gears associated with the toothed segments of the gear-wheels for effecting disengagement of the pinion from each of said segments when the other segment commences to mesh with the said pinion; a driven shaft, and means driven by the said gear-wheels for driving the driven shaft continuously in one direction.

12. In mechanism of the kind described, the combination of a power cylinder, a piston with a rack reciprocated thereby, a shaft, a gear meshing with the rack for driving the shaft, rotary means mounted for rotation on an axis extending longitudinally with the axis of the cylinder for arresting the rack at the end of the stroke of the piston, rotated by the rack when arrested, and means for imparting the torque developed in said rotary means to the said shaft.

13. In mechanism of the kind described, the combination of a power cylinder, a piston with a rack reciprocated thereby, a shaft, a gear meshing with the rack for driving the shaft, rotary means for arresting the rack at the end of a stroke of the piston, including a cam, means moving with the rack for engaging the cam to rotate said rotary means and develop torque therein when the movement of the rack is arrested, and means for imparting the said torque to said shaft.

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