

June 21, 1949.

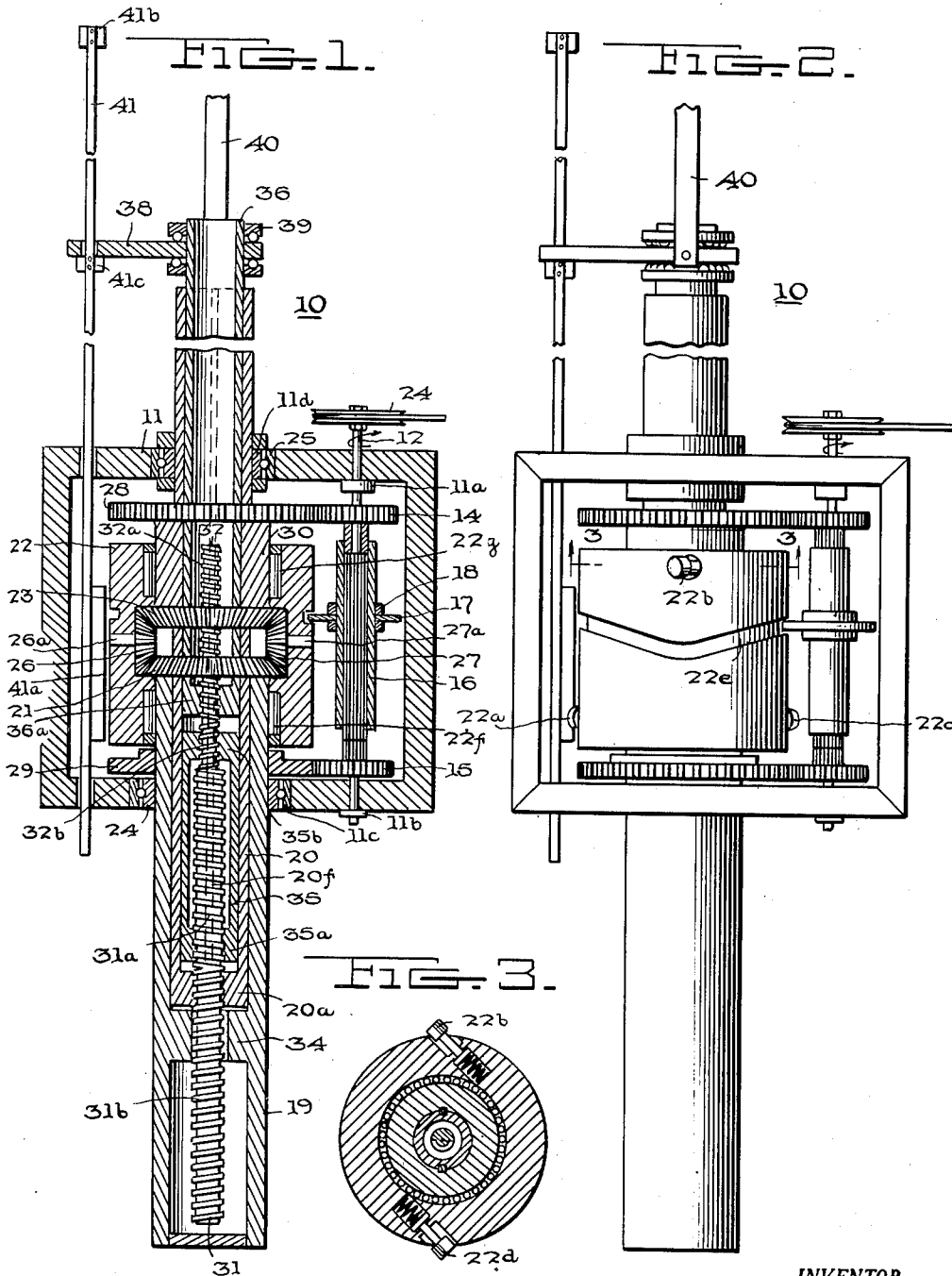
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2,473,566

SELF-REVERSING POWER JACK

Filed April 4, 1946

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FIG. 4.

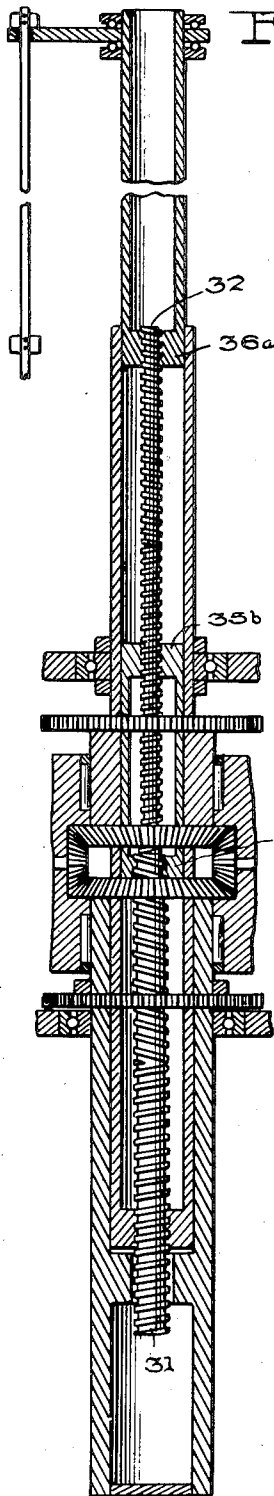


FIG. 5.

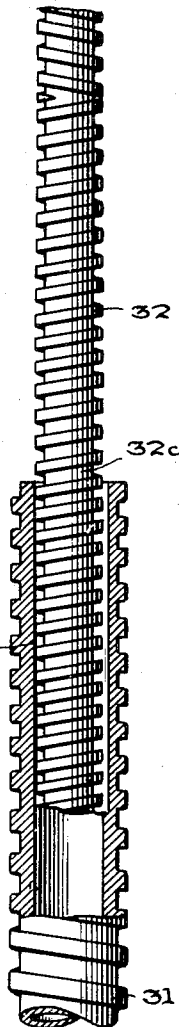
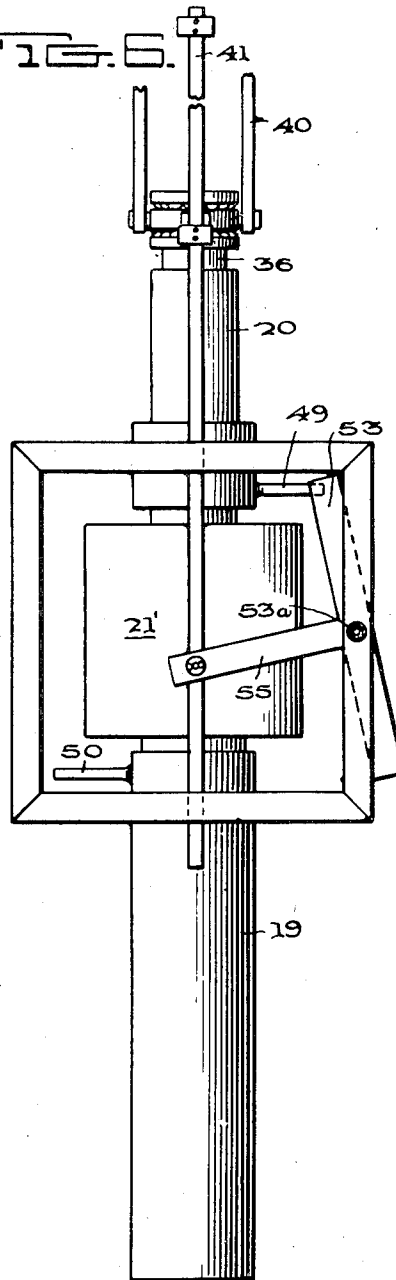


FIG. 6.



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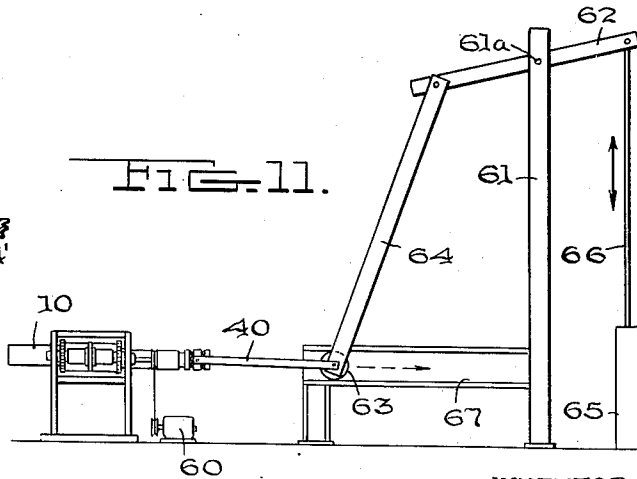
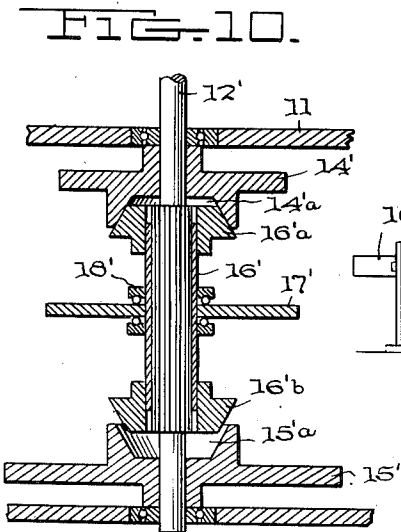
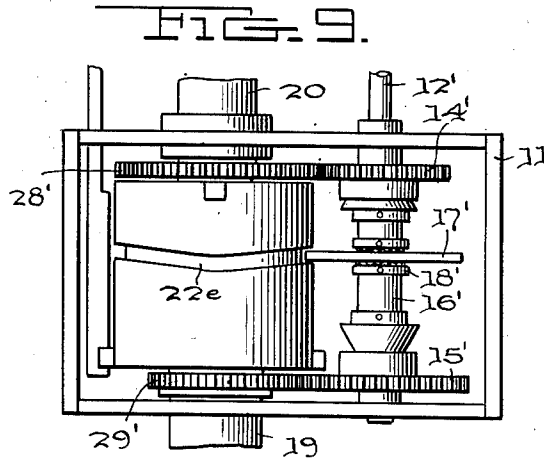
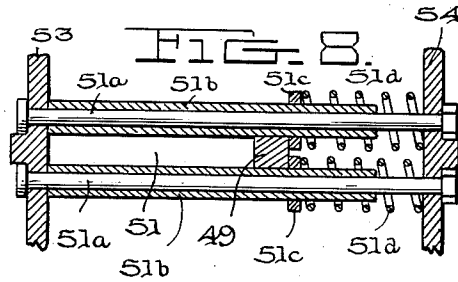
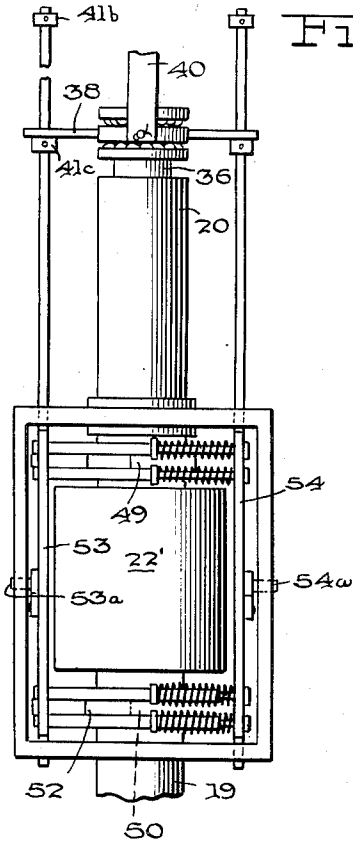
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3 Sheets-Sheet 3



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2,473,566

SELF-REVERSING POWER JACK

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Application April 4, 1946, Serial No. 659,595

18 Claims. (Cl. 74-25)

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This invention relates to power transmitting apparatus and mechanical movements, and more particularly to motion converting mechanism.

One of the objects of my invention is the provision of reliable and highly satisfactory motion converting mechanism which efficiently and readily effects the conversion of rotary motion to linear motion.

Another object is the provision of power transmitting mechanism whereby unidirectional rotation from a source of motion is readily and effectively transformed into linear or reciprocatory action.

A further object is to provide mechanism of the character referred to which is simple to install, and which is well calculated to serve under many different conditions of actual practical use.

Another object of my invention is the provision of power transmitting apparatus, as for example a power transmitting system, including and utilizing motion converting mechanism of the character noted.

A still further object is the provision of rotary to linear motion mechanism capable of simultaneously developing multiple rotations contributing to the achievement of quick strokes of linear movement.

A further object is to provide efficient and practical mechanism for automatically converting rotary motion to reversing strokes or reciprocation, all with minimum stress on working parts during reversal of any given stroke.

Other objects in part will be obvious and in part pointed out hereinafter.

My invention therefore consists in the combination of elements, features of construction and arrangement of parts, as described herein, the scope of the application of which is indicated in the following claims.

In the accompanying drawing illustrating certain features of my invention:

Fig. 1 depicts an embodiment of the rotary to linear or reciprocatory motion converting mechanism in sectional elevation;

Fig. 2 represents, in elevation, the same apparatus as in Fig. 1;

Fig. 3 is a horizontal section of the mechanism taken substantially on the line 3-3 in Fig. 2;

Fig. 4 is a fragmentary view of certain rotative and reciprocative elements represented in Fig. 1;

Fig. 5 presents in detail a form of joint for transmitting rotation and reciprocation;

Fig. 6 depicts, in elevational view, a modified form of stroke selector means of the conversion mechanism;

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Fig. 7 is a sectional elevation corresponding to Fig. 6;

Fig. 8 is a fragmentary view of certain detent mechanism of the modified stroke selector means;

Fig. 9 is a view, in elevation, representing modified unidirectional rotary motion transmitting means of the rotary to linear or reciprocatory motion converting mechanism;

Fig. 10 is a fragmentary sectional elevation of certain elements represented in Fig. 9; and

Fig. 11 schematically represents a power transmitting system including a rotary to reciprocatory motion converting mechanism.

Similar reference characters designate corresponding parts throughout the figures.

As conducive to a clearer understanding of certain features of my invention, it may be noted at this point that mechanisms for converting rotary motion to linear motion have come into widespread demand for such purposes as in the pumping of fluids, in tooling and machining operations, for the steering of craft, in operating power presses and hoists, and for a great variety of other uses including those in which a linear mechanical movement as derived from rotary motion is depended upon to set related equipment or transmit linear impulses to the same. While there are quite some few rotary to linear motion mechanisms in the prior art, many of these are open to such objections as being difficult of control during use, particularly as regards the achievement of satisfactory and reliable reversal of strokes or continuation of an arrested stroke, for making up the linear movement. Then too, certain of the prior art mechanisms are not readily adaptable to receive unidirectional rotary motion from a suitable source of power and convert the same to linear motion. Still other heretofore known motion converting mechanisms lack efficiency and positiveness of mechanical action. In other instances mechanisms are so mechanically complicated and space consuming as to render installation inadvisable.

An outstanding object of my invention accordingly is the provision of a simple, compact and reliable motion converting mechanism wherein a transition from unidirectional rotary motion to reciprocatory motion is positively and efficiently achieved under highly satisfactory conditions of reversing or alternating the stroke of reciprocation.

Referring now more particularly to the practice of my invention, attention is invited to Figs. 1 and 2 of the drawings wherein there is represented a motion converting mechanism, generally indi-

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cated by the numeral 10. This illustrative mechanism of my invention includes a suitable casing 11, through which there extends a drive shaft 12, the latter being journaled as in bearings 11a, 11b, and illustratively forming an included part of selectively operative means for transmitting unidirectional rotation to either of oppositely disposed co-axial gears 21 and 23 of epicyclic or differential gearing. Two gears, 14 and 15, and an intermediately positioned sleeve 16 are mounted on the shaft. The gears just mentioned are capable of idling, and of becoming driving gears when engaged into service by selective movement of sleeve 16 which is splined to the drive shaft in such fashion as to be free for longitudinal movement to locking engagement with the respective gears. Selection means, for example including a cam follower, is employed for imparting longitudinal motion in either direction to the sleeve thus to engage either gear 14 or gear 15 and lock the same to the drive shaft. The cam follower conveniently is a centrally perforated metal disc 17 received on sleeve 16, and free for rotation between collars 18 fixed to the sleeve.

The gears 14 and 15 mesh in power transmitting relation with corresponding gears 28 and 29 (Figs. 1 and 2) which are fixed to respective ones of sleeves 19 and 20, co-axially telescoped for relative rotation. The sleeve 19 is supported in bearing 11c in the wall of casing 11, and extends into gear box 22 through bearing 22f of the latter. Sleeve 20, on the other hand, conveniently passes through the gear box, through bearing 11d in the casing wall, and co-axially supports collar 35 journaled in bearing 22g of the gear box.

The bevel gears 21, 23 in the gear box are connected for rotating with the corresponding sleeves 19 and 20; the collar 35, gear 23 and gear 28 conveniently being integral and keyed to shaft 20 as a unit. Pinions 26 and 27 carried by spider means, illustratively including the gear box 22 and stub shafts 26a, 27a, join the bevel 21 and 23 thereby forming with the same an epicyclic or differential gear.

The apparatus of the mechanism thus far described is conveniently traced from a suitable source of power, as for example an operating electric motor which drives through a belt and pulley system 24 so as to impart clockwise rotation (as denoted by arrow in Figs. 1 and 2) to the drive shaft 12. Assuming the gear 14 to be locked to the drive shaft and gear 15 to be free of the clutch sleeve as shown, a counter-clockwise rotation is transmitted through the power take-off gear 28 to sleeve 20 and bevel gear 23 of the differential gearing. With the gear box restrained against rotation on bearings 22f, 22g, as by stop mechanism to be described hereinafter, the bevel gear 23 drives pinions 26 and 27, thus imparting a clockwise rotation to the bevel gear 21 and also to the related sleeve 19 and gear 29. The motion from gear 29 is received by the meshing idler gear 15. The circumstances assumed, therefore, are such that the sleeve 19 rotates in a clockwise direction and the co-axial sleeve 20 rotates counter-clockwise.

With the drive shaft 12 still rotating in the clockwise direction as before, and assuming the gear box to be held against rotation, but with gear 15 engaged by the clutch sleeve and gear 14 free of the sleeve, the gear 29 transmits a counter-clockwise rotation to sleeve 19 and the related bevel gear 21. This rotation is reversed through pinions 26 and 27, the bevel gear 23, sleeve 20 and gear 28 accordingly rotate in a clockwise direction.

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Motion from gear 28 is received by gear 14 which now is an idler gear.

It will be seen that a general effect of operating the drive shaft in a constant direction of rotation and alternately selecting one of the gears 14 and 15 as the driving gear, is that of alternately rotating the sleeve 19 in one direction and then in the other while sleeve 20 rotates in the opposite direction. This same effect, I find, is a highly useful measure in converting rotary motion of the drive shaft 12 into reciprocatory motion. In the present embodiment, sleeves 19 and 20 are simultaneously utilized for rotating threaded rods and threaded nuts in opposite directions and, alternatively, in reversed opposite directions, as for example, threaded cylindrical rods 31, 32 and nuts 20a, 35a, 35b and 36a, to produce reciprocation. The rods 31, 32 are disposed in co-axial relation to the sleeves. The rod 31, illustratively, is considerably larger in diameter than rod 32. Both rods have right hand threaded sections and left hand threaded sections along the cylindrical surfaces thereof, the right hand threads being indicated by reference characters 31a, 32a, and the left hand threads by 31b, 32b. There is a union or spline 33 (Fig. 5) connecting the threaded shaft ends for relative longitudinal movement and for rotation as a unitary shaft. The union, or joint, conveniently includes a grooved section 32c of the rod 32, and a bored and internally feathered section 31c of rod 31 into which the grooved section telescopes and fits. A similar connection is established by joint 34, in which the rod 31 is splined to sleeve 19 for rotation therewith yet is free for longitudinal displacement relative to the sleeve.

Each threaded section of the rods is in operative engagement with a corresponding nut which rotates with the power receiving sleeve 20. In this sense, threaded section 31b accommodates the nut 20a, which conveniently also forms an end of the power receiving sleeve 20 and is fixed in longitudinal position along with the rest of the sleeve as by the journal in bearing 25. The remaining nuts 35a on threaded section 31a, 35b on section 32b, and nut 36a on section 32a, are feathered for riding longitudinally in grooves 20f (represented by dotted lines in Fig. 1) in the inner surface of sleeve 20. By suitable means, the nuts 35a and 35b are held a constant distance apart on the rods, and to that end conveniently form integral parts of a plug 35. The nut 35a illustratively is fixed to a reciprocatory motion output member 36, which for example includes a hollow cylindrical sleeve co-axially telescoped into the power receiving sleeve 20 and riding in the grooves 20f for rotation.

As pointed out hereinbefore, when shaft 12 is driving in a clockwise direction through gear 14, a counter-clockwise rotation is imparted to sleeve 20 and a clockwise rotation to sleeve 19; provided the gear box 22 is restrained. Thus, under these conditions, and with the rods and nuts of the linear motion mechanism ready to begin a stroke from the lower stroke position represented in Fig. 1, the power receiving sleeve 20 rotates all of the nuts 20a, 35a, 35b and 36a, in a counter-clockwise direction. The threaded rods 31 and 32, on which the nuts rotate, are themselves rotating, this being in a clockwise direction determined by the clockwise motion of the power receiving sleeve 19 transmitted through joint 34 between the sleeve and rod and through union 33 between the rods. There ensues a highly positive and efficient displacement wherein the

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longitudinally fixed, but rotating nut 20a acts with threaded section 31b of the oppositely rotating rod 31 to elevate the latter to the completed upper stroke position represented in Fig. 4. This upward displacement is possible in view of the spline type connection 34. Meanwhile, nut 35a is carried upward the distance contributed by the action of nut 20a, and by engagement and opposed rotation with the threaded section 31a on the rod is driven upward a further amount corresponding to the threads traversed on the rod. Since nuts 35a and 35b are held a constant distance apart and are respectively mounted on the rods 31 and 32, the upward movement of the nut 35a is transmitted to nut 35b and the corresponding rod 32. The rod 32 accordingly slides up as permitted by the union 33. In addition, the relative rotation of nut 35b and threaded section 32a advances rod 32 farther upward by an amount corresponding to the threads traversed. The upward advancement of the rod 32 meanwhile is accompanied by the respective clockwise and counter-clockwise rotations of threaded sections 31a and nut 35a, which serves to elevate the nut and the related reciprocatory motion member 36 to top stroke position represented in Fig. 4. A coupling, including arm 38 adapted for idling in ball and cage bearings 39, is convenient for transmitting the longitudinal stroke of member 36 to reciprocative member 40 without transmitting any rotation of the sleeve.

Upon driving the reciprocatory motion member 36 to top stroke position, the power receiving sleeves 19 and 20 are reversed in rotation promptly by shifting the clutch sleeve 16 from gear 14 to coupling engagement with gear 15 and still maintaining clockwise rotation of the drive shaft 12. I usually achieve this shifting action by automatic selector means synchronized with stroke of the reciprocatory movement, and preferably through freeing the housing of the differential gearing for rotation at the proper time, and relying upon the ensuing movement to effect the shift. Conveniently, for this purpose, a slide 41 extends through opposite side walls of the casing 11 and presents a bracket 41a for engaging buffer spring loaded detents 22a, 22b, 22c and 22d uniformly spaced on the circumference of the cylindrical housing of gear box 22 and protruding from the wall. A cam path or groove 22e in the housing of box 22 (Fig. 2) receives the cam follower 17 and has a sweep sufficient to shift the clutch sleeve 16 on drive shaft 12 from driving or locking connection with one of gears 14 and 15 momentarily to interlocking engagement with both gears and then to driving engagement with the other for each quarter revolution of the housing. For synchronizing the initiation of the camming action just mentioned, with completion of strokes in the reciprocating movement of sleeve 36, there are suitably spaced stops 41b, 41c fixed on the slide 41 on opposite sides of arm 38.

It will be appreciated that by rotation of the differential gear as a unit while reversing any gear stroke of the reciprocatory movement, the threaded rod and nut combination is immediately relieved of related rotation and remains in neutral until the shift is completed. This enables accurate control over length of stroke of the reciprocating movement. Further the shifting of stroke direction is achieved with minimum stress since the rod and nut mechanism is not under working load once the differential gearing is released for rotation as a unit.

In the present instance of operation let it be

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assumed that the gear box housing is held against rotation by detent 22a resting on bracket 41a just before completion of the up stroke of sleeve 36. The sleeve in moving upward contacts stop 41b thus carrying bracket 41a free of detent 22a. This frees the differential gear box for rotation, under which conditions bevel gears 21, 24 and pinions 26a, 27a rotate as an interlocked unit all in the same direction with the power receiving sleeves 19 and 20 momentarily under the action of driving gears 14, 15 and gears 28 and 29. Since the drive shaft 12 is rotating clockwise, the sleeves 19 and 20, differential gearing, and gear box 22 all rotate counter-clockwise substantially as a unit until detent 22b contacts the bracket 41a. The rotation sweeps cam follower 17 along path 22e and consequently sleeve 16 into engagement first with both gears 14 and 15, and then with gear 14, and meshing gear 28 now becomes the driving gear. As already described, the gear 15 for clockwise rotation of the drive shaft imparts a counter-clockwise motion to sleeve 19 and a clockwise rotation to sleeve 20. Under these conditions the threaded rods 31 and 32 are driven clockwise and the corresponding threaded nuts are driven counter-clockwise. This action serves to return the rod 31 through the longitudinally fixed and rotating nut 20a and joint 34 to lower stroke position represented in Fig. 1. The downward displacement carries nut 35a down a corresponding amount, and by engagement and opposed rotation with the threaded section 31a travels down the rod to lower stroke position, also carrying along the nut 35b as permitted by union 33. The latter nut contributes in lowering rod 32 by travelling up threaded section 32a. As the rod 32 is lowered, nut 35a and member 36, arm 38 and reciprocative member 40 also are lowered. A further lowering action is produced by the nut 35a, by virtue of relative rotation with the rod.

Simultaneously with the reaching of lower stroke position, arm 38 forces down lug 41c and bracket 41a, thereby freeing detent 22b and consequently the gear box 22. Since the drive shaft 12 still is rotating clockwise, the sleeves 19 and 20, the differential gearing, and gear box 22 once more rotate counter-clockwise as a unit, this time until detent 22c contacts the bracket 41a. The rotation sweeps cam follower 17 along path 22e, thus bringing sleeve 16 into drive shaft coupling relation with gear 15, which then drives the mechanism through an up stroke of reciprocatory motion in a manner already noted.

The Figs. 9 and 10 illustrate a modified drive for operating the sleeves 19 and 20 in opposite directions and at different speeds thus to drive the threaded rod and nut arrangement more rapidly in one direction of stroke as compared with the opposite direction. The modification includes drive shaft 12' and related mechanism for transmitting power from a suitable source into the casing 11. There is a small gear 14' on the shaft in low speed gear train with relatively large gear 23'; also large gear 15' is on the shaft in high speed operating connection with a smaller gear 29'. The gears 28' and 29' illustratively are substituted to perform at different speeds the described functions of gears 28 and 39. I employ a sleeve 16' splined to drive shaft 12' for alternately coupling the gears 14', 15' to the source of power, while the other is released for idling. The sleeve illustratively includes friction plates 16'a, 16'b for effecting the desired coupling through either of corresponding friction surfaces 14'a, 15'a of the gears. A suitable cam follower 17', in bearings 18'

on the sleeve, rides in cam path 22e of the gear box 22 for alternately displacing the sleeve to locking engagement with the gears 14' and 15' to reverse the rotations of sleeves 19 and 20.

In Figs. 6, 7 and 8 there is represented a modified form of power converting mechanism which instead of depending upon the simultaneous opposite rotation of threaded nuts and threaded rod means for producing reciprocation, achieves the reciprocatory motion with a differential gear and sleeves 19 and 20 as before, but by the alternate procedures of holding the related nuts 20a, 35a, 35b and 36a (Fig. 1) against rotation while rotating the threaded rods 31, 32, and rotating the nuts while holding the rods. This sequence of operations is effectively and efficiently performed by alternately restraining the sleeves 19 and 20 against rotary motion while driving the gear itself in a constant direction of rotation as the motion transmitting means which is selectively operative with the differential gearing. The sleeves illustratively support respective levers 49 and 50, which extend laterally in opposite directions and co-function with detents 51 and 52, respectively, for stopping the individual sleeves. A detent carriage including frame members 53, 54 which support the detents 51, 52 at opposite ends thereof to form a substantially rectangular frame, is axially hinged at 53a, 54a for rotation by means of arm 55. The detent 51 comprises two substantially parallel bolts 51a (Fig. 8) interconnecting the frame members 53 and 54. Each bolt accommodates a sleeve 51b, which is equipped with a fixed lug 51c and is adapted for sliding movement against the action of a buffer spring 51d. The lugs on the sleeves are adjacent, and jointly present a surface for receiving and holding lever 49. Detent 52 is of similar construction and is adapted for receiving and holding the lever 50 against rotation.

To reverse the stroke of reciprocatory motion developed by driving the gear box 22', the differential gearing therein, and sleeve 19 while holding sleeve 20 by lever 49 and detent 51, the detent carriage is rotated to engage lever 50 on sleeve 19 with detent 52. This serves to release lever 49 from detent 51 and consequently frees the sleeve 20 for rotation. Momentarily, there is a unitary rotation of sleeves 19, 20 and the differential gear, all in one direction by virtue of continual unidirectional driving of the housing of gear box 22' in the direction indicated by arrow in Fig. 8. Thus, lever 50 engages detent 52, thereby restraining sleeve 19, and leaving sleeve 20 free for rotation under power from the rotating box 22' and differential gearing therein. The rotation of sleeve 20 reverses the stroke of reciprocation. A further reversal of stroke is indicated by positioning the detent carriage to engage lever 49 and detent 51, and free lever 50 and detent 52. With lever 50 free, there is once more a unitary rotation of sleeves 19, 20 and the differential gear, all in one direction, assuming continued unidirectional driving of the gear box 22'. The lever 49 then strikes detent 51, whereby further motion of sleeve 20 is arrested and rotation of sleeve 19 continues throughout the reversed stroke.

In automatically operating the motion converting mechanism of the present embodiment, the appropriate detent 51, 52 is swung to locking engagement with its corresponding lever 49, 50 under force transmitted from sleeve 36, arm 38 and lug 41b or 41c and through slide 41 to arm 55. This linkage is so adjusted as to alternate the

holding and release of levers 49 and 50, thereby alternately reversing the stroke of sleeve 37.

Referring to Fig. 11 of the drawing, there is illustrated a form of power transmitting system in accordance with my invention. In the system, a suitable motor 60 is connected for operating a reciprocative pump in well 65 through one of my motion converting mechanisms 10 connected by means of reciprocative member 40 through well derrick linkage to pump shaft 66. The well derrick is equipped with an upstanding frame 61 which supports a pumping arm 62, fulcrumed at 61a and connected at one end to the pump shaft 66. A roller 63 connected in an articulated joint between adjacent ends of link 64 and reciprocative member 40 is guided in track 67. At opposite end, the link 64 is hinged to the pumping arm 62 and is of such length and so guided by the roller 63 as to transmit an up and a down stroke to the pumping arm, and consequently to the pump, for each single stroke from the mechanism 10.

It will be appreciated that while the mechanism for converting rotary motion, as herein described, is highly suited for the output of alternately reversed strokes of reciprocation of constant amplitude, the mechanism may be reversed as desired along the length of any given stroke, as by manual or automatic control applied to slide 41 (Figs. 1 and 6) or may be stopped and started once more, to continue in a given direction, as by stopping the drive 24 and then resuming the drive in the same direction as before.

While two telescoping threaded rods have been described for coaction with threaded nuts for achieving reciprocatory motion in the embodiment hereinbefore set forth, it will be understood that a single threaded rod may be employed in conjunction with one or more nuts for coacting therewith for producing linear motion or reciprocation.

Since many possible embodiments may be made of my invention and since many changes may be made in the embodiments hereinbefore set forth, it will be understood that all matter described herein, or shown in the drawings, is to be interpreted as illustrative and not as a limitation.

I claim:

1. In mechanism for converting rotary motion to reciprocating linear motion, the combination which includes, motion converting means comprising at least two engaging threaded members mounted for relative rotation and co-action to produce linear displacement of one of them, gearing means connective with said threaded members for transmitting opposite driving rotation to the same to direct the displacement, and means controlled by movement of said member to reverse the direction of rotation of both said members.

2. In mechanism for converting rotary motion to linear motion, the combination which includes, motion converting means comprising at least two engaging threaded members mounted for relative rotation and co-action to produce linear displacement of at least one of them, differential gearing having a pair of differential gears each connected for rotation with one of said threaded members, and means for selectively coupling the differential gears to rotary drive means of fixed direction rotation.

3. In mechanism for converting rotary motion to reciprocatory motion, the combination which includes, motion converting means comprising at least two engaging threaded members mounted for relative rotation and co-action to produce reciprocation of one of them, differential gearing

having corresponding gears thereof connected for driving the corresponding ones of said threaded members, and means for alternatively coupling said corresponding gears to a rotary drive source of fixed rotation, and a pinion between said corresponding gears mounted on a normally fixed axis.

4. In mechanism for converting rotary motion to reciprocatory motion, the combination which includes, motion converting mechanism comprising at least two engaging threaded members mounted for relative rotation to produce displacement of at least one of them, mechanism for simultaneously transmitting opposite rotations to said threaded members to achieve the displacement and means dependent on the amount of said displacement in either direction to reverse the direction of said rotations.

5. In mechanism for converting rotary motion to reciprocatory motion, the combination which includes, motion converting mechanism comprising at least two engaging threaded members mounted for alternately reversed opposed rotation to produce reciprocation, drive means operating in a constant direction, means connecting said drive means for alternately rotating said threaded members in opposed directions, and gear means for interconnecting the threaded members in opposed rotary relation during operation of said drive means.

6. In mechanism for converting rotary motion to linear motion, the combination which includes, differential gearing, unidirectional rotary motion transmitting means selectively operative with said differential gearing for driving through opposite sides of the same, and two members each connected for simultaneous rotation with one of the opposite sides of said differential gearing and mounted for co-action to produce linear displacement.

7. In mechanism for converting rotary motion to linear motion, the combination which includes, differential gearing, unidirectional rotary motion transmitting means selectively operative with said differential gearing for alternately driving through opposite sides of the same, at least two engaging threaded members each rotatable with one of said opposite sides of the differential gearing and mounted for co-action to produce linear displacement, and selective means actuated by movement of one of said threaded members for engaging said unidirectional motion transmitting means to driving relation alternately with one or the other of said opposite sides of the differential gearing thus for producing reversed strokes of reciprocation with said threaded members.

8. In mechanism for converting rotary motion to reciprocatory motion, the combination which includes, differential gearing comprising opposed gears and at least one interconnecting pinion for the same, unidirectional rotary motion transmitting means selectively connective with the differential gearing alternately through said opposed gears, at least two engaging threaded members rotatable each with one of the opposed gears of the differential gearing and mounted for co-action to produce reciprocation, and selector means for automatically setting said unidirectional motion transmitting means to driving relation with the differential gearing alternately through said opposed gears thus producing alternately reversed strokes of reciprocation with said threaded members, said selector means including means for restraining the axis of the interconnecting pinion of said differential gearing

from rotation about the axis of the opposed gears throughout the individual strokes of reciprocation and intermittently releasing the same to actuate said selector means for reversing stroke.

9. In mechanism for converting rotary motion to reciprocatory motion, the combination which includes, differential gearing, unidirectional rotary motion transmitting means selectively operative with said differential gearing for alternately driving through opposite sides of the same at different speeds, at least two telescoping threaded members rotatable each with one of said opposite sides of the differential gearing and mounted for co-action to produce reciprocation, and selector means for engaging said unidirectional motion transmitting means alternately to driving relation with said opposite sides of the differential gearing thus for producing alternately reversed and differently speeded strokes of reciprocation with said threaded members.

10. In mechanism for converting rotary motion to reciprocatory motion, the combination which includes, differential gearing, unidirectional rotary motion transmitting means selectively connective with said differential gearing for driving through axially opposite sides of the same in alternately reversed directions, at least two telescoping threaded members rotatable each with one of said opposite sides of the differential gearing and mounted for co-action to produce reciprocation, and selective means automatically setting said unidirectional motion transmitting means alternately to driving relation with said opposite sides of the differential gearing thus for producing alternately reversed strokes of reciprocation with said threaded members.

11. In mechanism for converting rotary motion to reciprocatory motion, the combination which includes, differential gearing, including opposed differential gears and a pinion unidirectional rotary motion transmitting means selectively operative with said differential gearing for alternately driving opposite gears of the same in the same direction, selective means for automatically engaging said unidirectional rotary motion transmitting means alternately to driving relation with said opposite gears of the differential gearing and means to lock the pinion against rotation about the axis of the gears when driving either of them.

12. In mechanism for converting rotary motion to reciprocatory motion, the combination which includes, differential gearing comprising opposed gears and at least one interconnecting pinion for the same, unidirectional rotary motion transmitting means for selectively driving the differential gearing through said opposed gears, and means for restraining the axis of said interconnecting pinion from rotation about the axis of said gears and releasing the same only during selection of the driving relation between said unidirectional rotary motion transmitting means and the differential gearing.

13. The mechanism as defined in claim 3 in which means is provided to release the axis of said pinion upon a predetermined stroke of the reciprocable threaded member.

14. The mechanism as defined in claim 4 in which each of the threaded members is formed in at least two parts telescopically and non-rotatively secured together.

15. The mechanism as defined in claim 11 in which mechanism is provided to release the pinion during the change of drive.

16. The mechanism as defined in claim 15 in

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which cushion means are provided to stop the pinion rotation when gear selection is completed.

17. The mechanism of claim 8 in which each threaded member includes two portions relatively non-rotatable and of opposite pitch.

18. The mechanism of claim 17 in which at least one of said two part threaded means is comprised of telescoping parts.

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